FUNCTIONAL AND RADIOLOGICAL OUTCOME OF PERIPROSTHETIC FRACTURES FOLLOWING PRIMARY HIP ARTHROPLASTY

Dissertation submitted to

THE TAMILNADU DR.MGR MEDICAL UNIVERSITY,

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Award of the degree of

M.S. (ORTHOPAEDIC SURGERY)

BRANCH - II

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CERTIFICATE

This is to certify that this dissertation entitled "**FUNCTIONAL AND RADIOLOGICAL OUTCOME OF PERIPROSTHETIC FRACTURES FOLLOWING PRIMARY HIP ARTHROPLASTY"** is a bonafide work done by **Dr. S. JAYASANKAR**, **M.S. ORTHOPAEDIC SURGERY BRANCH - II** at Government Kilpauk Medical College, Chennai – 600 010, to be submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the University rules and regulations for the award of M.S. Degree Branch-II Orthopaedic Surgery, under my supervision and guidance during the period from May 2016 to May 2019.

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DECLARATION

I solemnly declare that this dissertation, "**FUNCTIONAL AND RADIOLOGICAL OUTCOME OF PERIPROSTHETIC FRACTURES FOLLOWING PRIMARY HIP ARTHROPLASTY"** is a bonafide work done by me at Govt. Kilpauk Medical College and Hospital, Chennai – 10 during the period from May 2016 to May 2019 under the guidance and supervision of my guide **Prof. Dr. M.ANTONY VIMAL RAJ M.S.Ortho,** Professor of Orthopaedic Surgery, Govt. Kilpauk Medical College and Hospital, Chennai – 10.

This dissertation is submitted to "**THE TAMILNADU DR.MGR MEDICAL UNIVERSITY",** Chennai in partial fulfillment of the University regulations for the award of degree of **M.S. BRANCH II ORTHOPAEDIC SURGERY.**

Place:

Date: **(Dr. S. JAYASANKAR)**

INSTITUTIONAL ETHICS COMMITTEE
GOVT. KILPAUK MEDICAL COLLEGE, CHENNAI-10
Protocol ID. No. 02/2017 Meeting held on 26.09.2017

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval **"Functional and radiological outcome of patients who underwent treatment for periprosthetic fracture following primary hip arthroplasty"** submitted by Dr.S.JAYA SANKAR, Post Graduate,M S Ortho., Govt. Kilpauk Medical College, Chennai-10.

The Proposal is **APPROVED.**

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

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CONTENTS

PERIPROSTHETIC FRACTURES

INTRODUCTION

By definition, Periprosthetic fractures are that occur with a prosthesis or part of it, insitu. They can result from trauma, fatigue, osteolysis and pathologic bone[1]. Trauma can occur both intra-operatively or post operatively.

Practically, every joint replacement in the body can be involved, but lower extremity periprosthetic fractures are more common due to higher mechanical forces[2].

All types of periprosthetic fractures can present unique and substantial treatment challenges. In each situation, the presence of an arthroplasty component either obviates the use of, or increases the difficulty of, standard fixation techniques. These fractures often occur in elderly patients with osteoporotic bone making good fixation with traditional techniques problematic[3].

Age of the patient, the biological and mechanical factors can be responsible for a periprosthetic fracture. While a disturbed blood supply to the bone after insertion of the prosthesis may account for a biological deficit, the lack of mechanical stability can be explained by poor quality or loss of bone. Bone deficiency or resorption may also be caused by less than ideal placement and alignment of the prosthesis in the first place. This results in non-

physiological loading of the surrounding bone, which in turn may create stress risers.

These fractures continue to increase in frequency due to increase in number of arthroplasties and also increasing age and fragility of patients with such implants[4]. An increased population load of patients will have had revision arthroplasty, which in itself is another independent risk factor for periprosthetic fractures[5].

These fractures were classified according to a simple "Unified Classification System (UCS)", similar to that of the AO/OTA classification and Vancouver classification. Besides the classification of the fractures, the assessment of the patient and careful decision-making process, the treatment of periprosthetic fractures demands an experienced surgeon.

The challenges in treating such fractures include

1. Poor bone stock.
2. Osteolysis.
3. Altered anatomy.
4. To manage joint prosthesis and the fracture concomitantly[6].

The difficulty in management of periprosthetic fractures regardless of location is evidenced by the array of treatment options described in the literature without a clear consensus emerging on the most appropriate method[7,8,9,10,11].

These fractures result in considerable morbidity and dysfunction of the patients[12]. In regard to the technology and design of new prostheses, the risk for periprosthetic fractures to occur should be noted. In view of the increasing incidence of uncontrolled falls and injuries of the steadily growing number of older patients, geriatric medicine should develop better and more effective prevention programs.

Therefore, a thorough understanding of risk factors, epidemiology is essential for both prevention and treatment of these fractures[13]. Surgeon should be familiar with different internal fixation techniques, revision arthroplasty, as well as biomechanics of involved joint and modern technique.

Future development of fracture care should endeavour to be least invasive, provided high stability, and at the same time biology of the bone and soft tissue healing is respected.

Most recently, treatment strategies to accelerate weight bearing have suggested benefits with regard to mortality[14,15].

HISTORICAL REVIEW

Periprosthetic fracture of the femur after hip arthroplasty surgery was first described by Horwitz and Lenobel in 1954[16]. It occurred in a female patient who sustained an intertrochanteric fracture around the stem of a cemented hemiarthroplasty whilst convalescing from the aforementioned operation. A transfixing bolt and wire loop were used to reconstruct and stabilise the femur before reinserting the prosthesis into the reduced femur. Unfortunately, the patient died one month following surgery.

Parish and Jones reported seven cases 10 years later in 1964. Their report was divided into fractures sustained in the trochanteric area, or in proximal, middle and distal areas of the femoral shaft thus giving rise to the earliest classification system of this injury.

Two years later, Sir John Charnley described a periprosthetic femur fracture, again in a female patient[17]. She was treated with a cemented Thompson prosthesis following a cervical hip fracture but fell seven months later. She consequently sustained an oblique fracture in the proximal part of the femur and was treated with balanced traction; the fracture was reported to have healed after 3 months.

The next large series of patients was reported by Whittaker et al. in 1974. It comprised of 20 cases in 19 patients; 17 hemiarthroplasties and 3

cemented Total Hip Arthroplasties[18]. Like Parish and Jones' series, early mobilisation, traction, long-stem revision or plates were used.

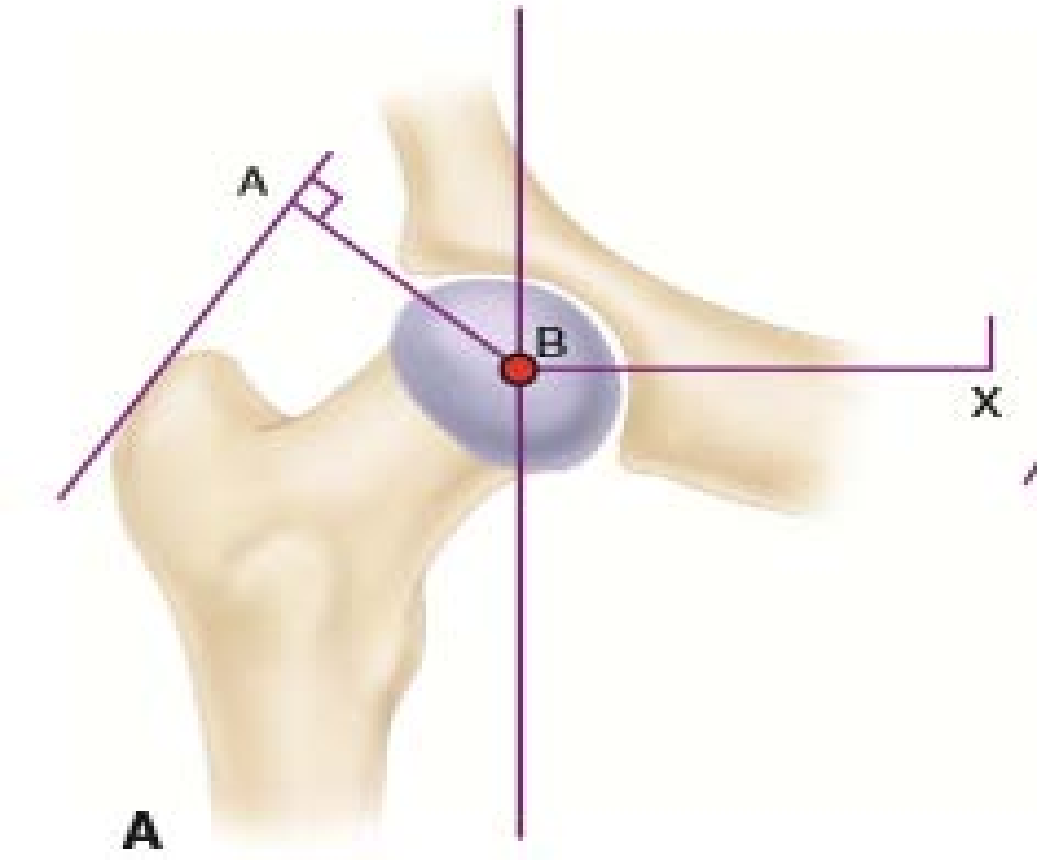
Whilst these surgeons were pioneers of their time, their experience with periprosthetic femoral fractures was limited. Today, the reconstructive orthopaedic surgeon deals with periprosthetic fractures frequently. Periprosthetic femoral fracture is a devastating complication after total hip arthroplasty that often results in poor clinical outcome[19,20]. They are challenging to treat, as they require both the skills of a Revision surgeon and those of a Trauma specialist.

BIOMECHANICS OF HIP

- The biomechanics of Total Hip Arthroplasty are different from those of screws, plates and nails.
- Latter, these implants provides only partial support and only until bone unites.
- Total hip components must withstand many years of cyclical loading equal to atleast three times the body weight.

Lever arms acting on hip joint

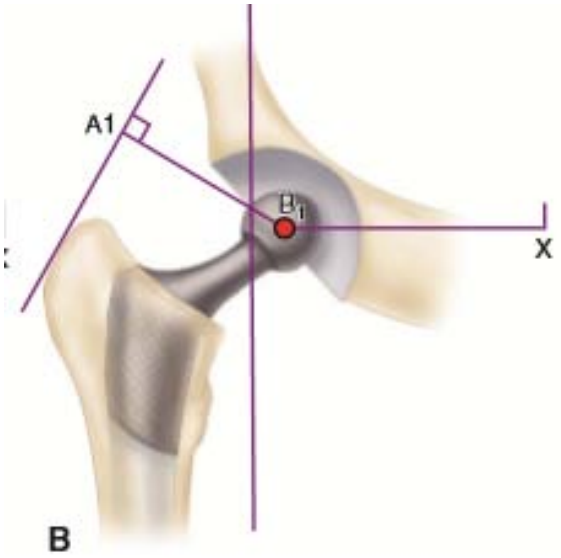
- X-Moment produced by body weight applied at body's centre of gravity acting on lever arm B-X.
- A-Moment produced Abductor's
- A-B Shorter lever arm.
- B-X must be counter balanced by A-B.

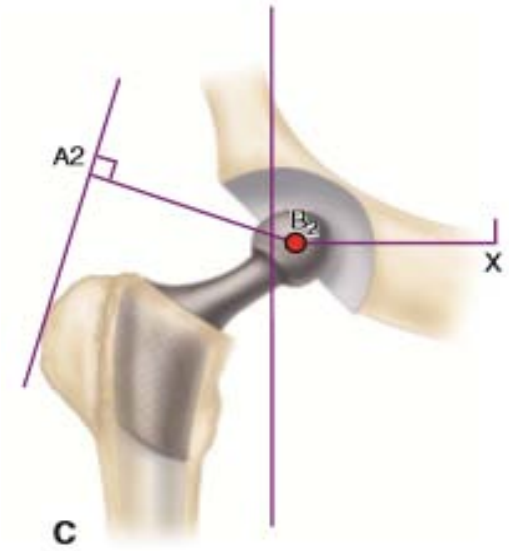


- Ratio of the length of the lever arm of the body weight to that of the abductor musculature is about 2.5:1.
- Abductor lever arm may be shortened in hip arthritis and other hip disorder involving loss of femoral head or neck shortening or DDH or when the trochanter is located posteriorly as in external rotational deformities[21].

CHARNLEY CONCEPT'S

- Shorten the lever arm of body weight by deepening acetabulum(B).
- And to lengthen the lever arm of the abductor mechanism by reattaching osteomized greater trochanter laterally(C).
- To achieve 1:1 ratio.





EPIDEMIOLOGY

i. Periprosthetic acetabular fracture

Intra-operative periprosthetic acetabular fractures are rare. Current overall incidence is unknown .Mostly under reaming of socket is probable cause. Earlier, a study[22] outlines on incidence of < 0.2%.

Post-operative periprosthetic acetabular fractures are more common than intra-operative periprosthetic acetabular fractures but still the incidence is very low.

ii. Periprosthetic femur fracture

Intra-operative periprosthetic femur fracture occur more commonly during revision procedures[23] and more with non-cemented stem[24] due to press fit design.

Incidence range from 0.1-2.5% with cemented stem and 3.7% - 5.4% with uncemented stem.

Increasing prevalence of post-operative periprosthetic fractures are due to various causes[25]. From mayo clinic registry, A total of 179 (1.8%) of 521 fractures occurred after placement of a non-cemented stem and 342 occurred after placement of a cemented stem (1.5%) following Primary Total Hip Arthroplasties.

CAUSES AND RISK FACTORS

i. Old age

ii. Female gender

iii. Osteoporosis

iv. Malnutrition

v. Metabolic disorder

vi. Neurological disorder

vii. Renal disorder

viii. Infection

ix. Chronic medication

x. Presence or absence of Osteolysis / Aseptic loosening

xi. Primary or revision status

xii. Cemented or non-cemented technique

xiii. Index diagnosis: RA, HIP fracture

xiv. Technique related risk factors

- Femoral broaching
- Over reaming
- Cortical stress risers
- Screw holes

- Previous osteotomy
- Aggressive insertion of press fit component.
- Under reaming
- Eccentric reaming
- During cement removal

xv. Implant related risk factors

- Large diameter stems
- Long stems especially straight stems
- Press fit non-cemented components

xvi. Number of years post surgery.

Risk factors for intra operative periprosthetic fractures

- Unique subset of associated risk factors

1. Force utilised during insertion.
2. The relative geometry of the stem and the femur.
3. The strength of the bone.
4. Stem design - Stem with combination of metaphyseal and diaphyseal fit with a cylindrical design.
5. Certain bone morphological patterns.

ASSESSMENT

i. Mechanism of injury

Low energy fall accounts for most of the upper and lower extremity periprosthetic fractures[26,27,28].

Lower extremity fractures tend to occur postoperatively rather than intra-operatively whereas a relatively larger proportion of upper extremity periprosthetic fractures, especially those about humeral shoulder arthroplasty stems, occur intraoperatively.

High energy fractures associated with comminuted fracture pattern[29] than seen with low energy fractures. Periprosthetic fractures are more common after revision arthroplasties than after primary arthroplasties, this is because of reduced bone stock after revision[30].

Intra-operative fractures of both the upper and lower extremities occur more commonly during revision procedures and with implantation of large noncemented stems[31,32]. The risk increases when there is mismatch between the shape of long prosthetic stems and the shape of the bone[33].

ii. Associated injuries

Because of low energy injury mechanism, associated injuries are relatively uncommon. But with high energy injury mechanism, patient should be evaluated as a whole.

iii. Signs and symptoms

While evaluating patients, history is very important. It includes status of arthroplasties like date of implantation, prosthesis used, the index diagnosis for implantation. The diagnosis is usually obvious, Patient had an abrupt onset of pain, deformity associated with trauma and sometimes, trauma may be trivial.

Patient should be evaluated for occult infection. It includes laboratory markers like CBC, DC, TC, ESR, CRP etc.

Patient's occupation, ambulatory status, history of mechanical symptoms such as pain, difficulty with ambulation, limb shortening etc, to be noted as they are associated with prosthetic loosening prior to fracture.

Venous stasis, diabetic ulcer, limb length evaluation, neurological status, status of abductors of hip and the extensor mechanism of the knee, renal status, pulmonary status, cardiac status should be evaluated.

In case of the displaced fracture, many of these parameters will be abnormal and not represent patient's baseline status. However, it is still important to obtain a comprehensive history for evaluation.

Direct observation of these fractures when occur intra-operatively. A change in pitch during insertion of trial or final prosthesis should alert the surgeon, the possibility of fracture. An abrupt easing of insertion resistance can be a subtle sign of fracture.

iv. Imaging modalities

-Plain Antero Posterior views and Lateral views of the joint.

-Computed tomography.

-Magnetic resonance imaging.

-Bone scan.

-DEXA scan.

-Bone mineral density (BMD).

v. Aspiration biopsy if infection is suspected.

CLASSIFICATION

A. periprosthetic acetabular fracture

- By Peterson and Lewalle.
- Based on stability of the acetabular component[34].

Type I Fractures

- Stable acetabular component.
- Associated with Little or no pain.

Type II Fractures

- Unstable or radiographically loose component.
- Notable pain with any motion of hip.

Another more comprehensive classification for periprosthetic acetabular fractures was proposed by **DAVIDSON et al.**

Type I fractures - Non displaced and cup stable.

Type 2 fractures - Non displaced but with potential instability pattern such as transverse or posterior column fracture.

Type 3 fractures - Displaced and inherently unstable.

B. Classification of intra-operative periprosthetic femur fracture

The original Vancouver classification was developed to describe post-operative fractures but later expanded to address intra-operative fractures.

Type A - Proximal metaphyseal fractures without extension to the diaphysis.

Type B - Diaphyseal fractures about the tip of the stem.

Type C - Fractures extend beyond the longest revision stem and include fractures of the distal metaphysis.

The sub classification of each type distinguishes the intra operative from the post operative classification and reflects fracture stability.

Subtype 1 - Simple cortical perforation.

Subtype 2 - Non displaced linear cortical crack.

Subtype 3 - Displaced or unstable fracture.

C. **Classification of post-operative Periprosthetic femur fracture.**

Vancouver Classification

Type A Fractures located in the trochanteric region.

AG Fractures involving greater trochanter.

AL Fractures involving lesser trochanter.

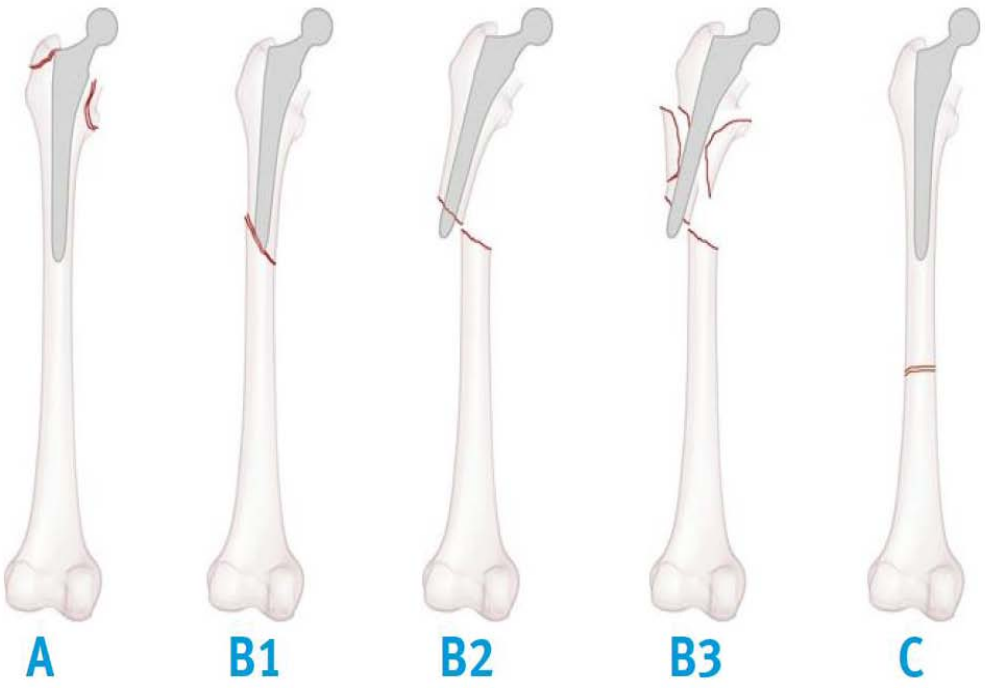
Type B Fractures around or distal to stem.

B1 Around or just distal to femoral stem, stem well fixed.

B2 Around or just distal to femoral stem, stem loose, good bone stock in proximal femur.

B3 Around or just distal to femoral stem, stem loose, poor bone stock in the proximal femur.

Type C Fractures well below the femoral stem tip.



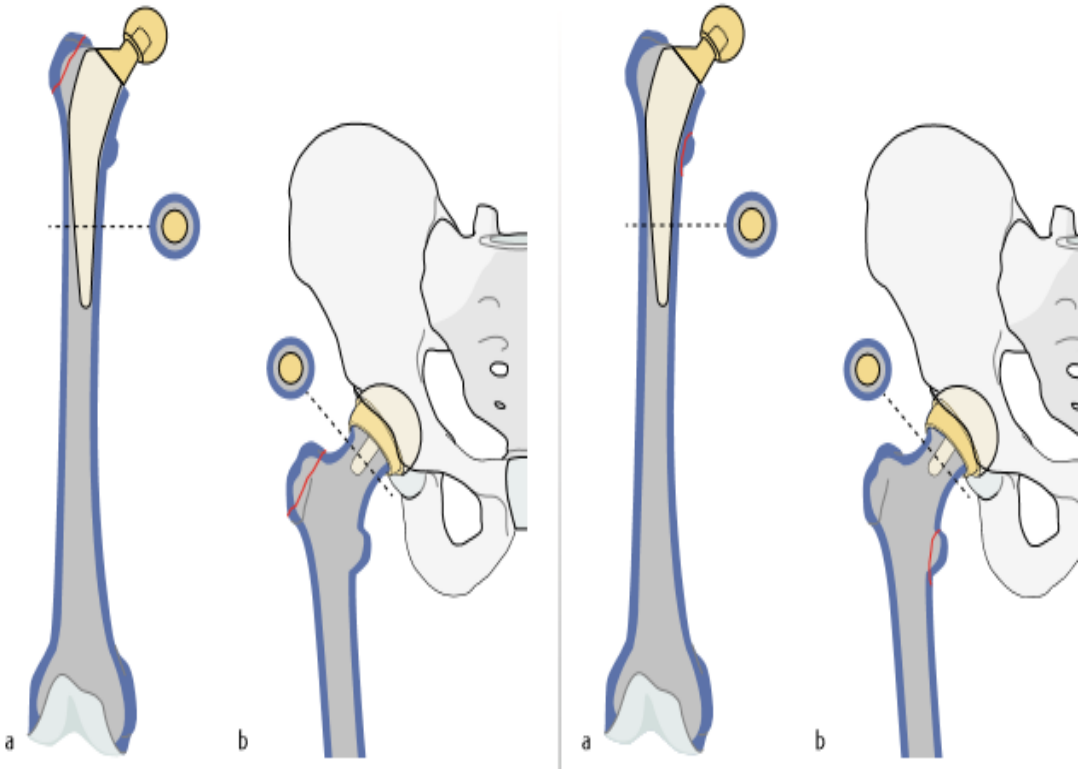
Another classification is the NEW UNIFIED CLASSIFICATION SYSTEM (UCS) for the proximal femur periprosthetic fracture.

New Unified Classification System for proximal femur After Total Hip Replacement and After Surface Replacement.

TYPE IV 3A (Apophyseal or periarticuar / juxta-articular)	A1: Greater Trochanter.
	A2: Lesser Trochanter.
TYPE IV 3B(Bed of the implant)	B1: Stem stable, good bone. Surface replacement: femoral neck.
	B2: Loose Stem, good bone. Surface replacement: loose implant. No proximal femoral bone loss.
	B3: Loose Stem, poor bone, defect Surface replacement: loose implant, bone loss.
TYPE IV 3C (Clear of the implant)	Distal to implant and cement mantle.
TYPE IV 3D (Dividing the bone between two implants)	Between hip and knee arthroplasties, close to hip.
TYPE IV 3E (Each of two bones supporting one arthroplasty)	Pelvis and femur.
TYPE IV 3F(Facing and articulating with a hemiarthroplasty)	---

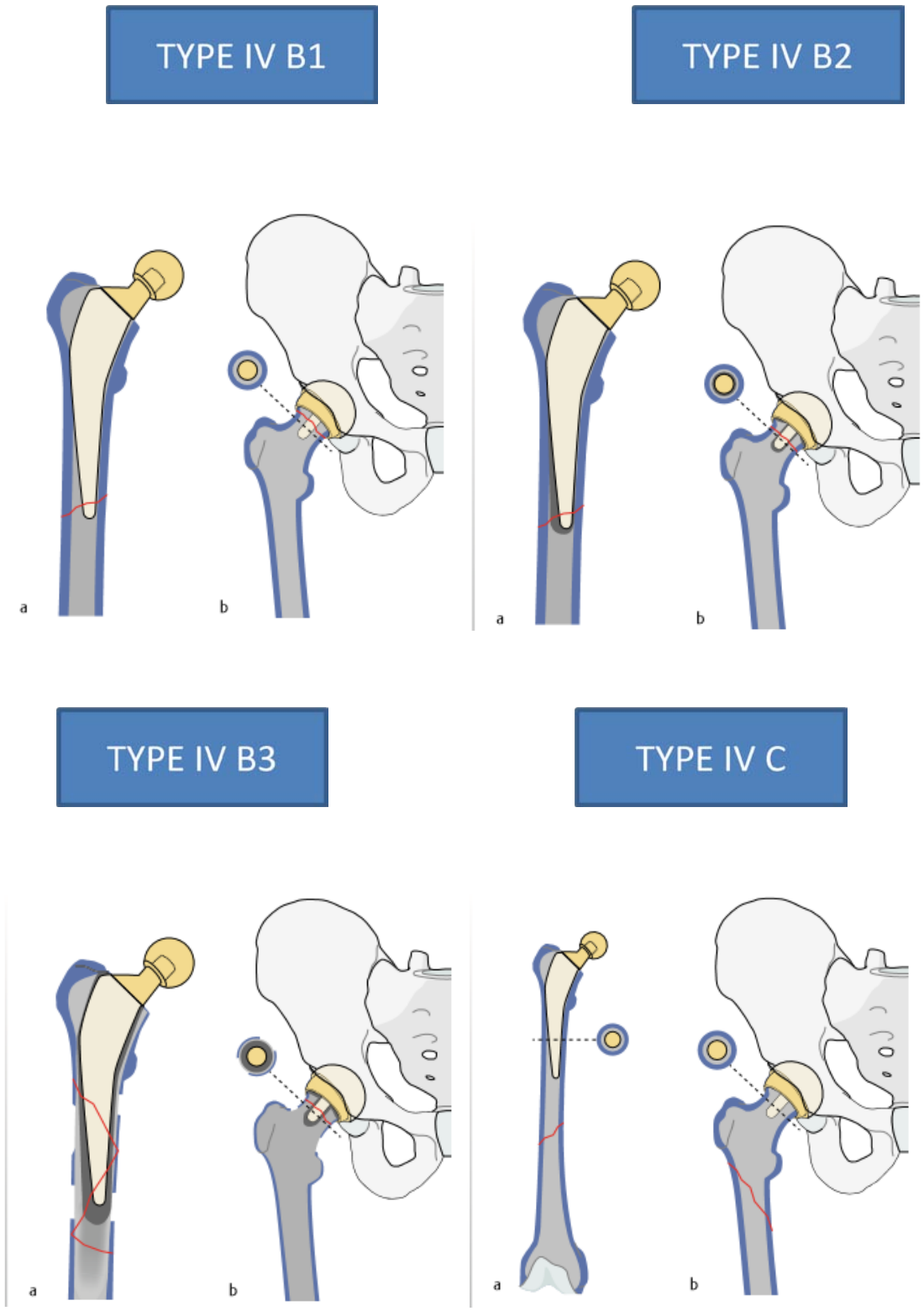
TYPE IV A1

TYPE IV A2



A - After Total Hip Replacement.

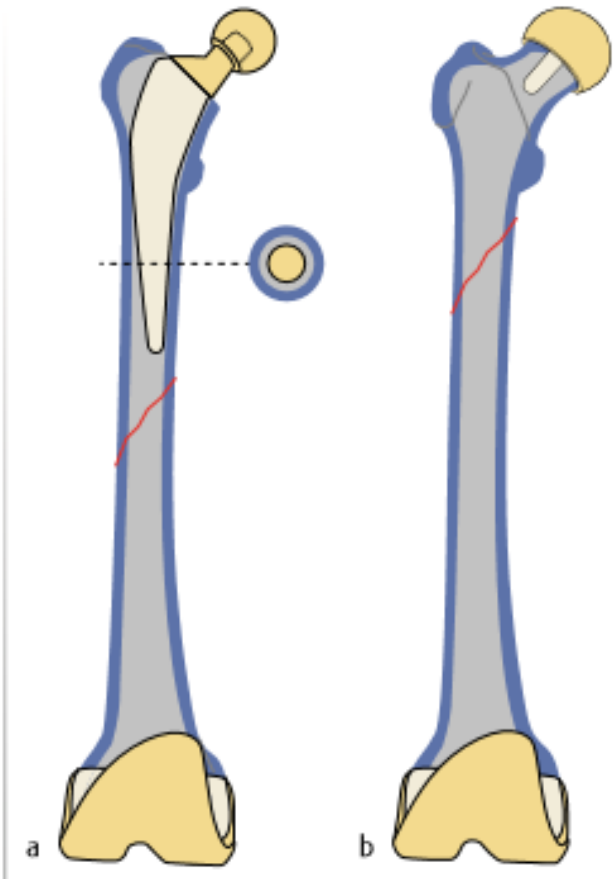
B - After Surface Resurfacing



A - After Total Hip Replacement.

B - After Surface Resurfacing.

TYPE IV D



A - After Total Hip Replacement.

B - After Surface Resurfacing.

The Vancouver classification of periprosthetic fractures is a validated and simple classification system that enables the surgeon to determine the most appropriate treatment option based on the location of the fractures, the stability and quality of the remaining bone.

Here, we followed Vancouver classification system for patient management and followed ENGH ET AL CRITERIA FOR CEMENTLESS STEM and HARRIS ET AL CRITERIA FOR CEMENTED STEM for judging the stability of femoral stem.

CRITERIA FOR JUDGING THE STABILITY OF FEMORAL STEM

ENGH ET AL CRITERIA- FOR CEMENTLESS STEM

- Presence of spot welds.
- Lack of radiolucent lines.
- Absence of pedestal formation.
- Absence of calcar remodelling.
- No evidence of migration.

HARRIS ET AL CRITERIA - FOR CEMENTED STEM

- Definitely loose - migration seen on serial radiograph.
- Probably loose- radiolucent zone at the bone cement interface.

MANAGEMENT

GOAL

1. Timely and uncomplicated fracture union.
2. Restoration of Alignment.
3. Return to pre injury level of pain and function.

i. PERIPROSTHETIC ACETABULAR FRACTURES

Pre- Operative planning

Position	:	Lateral
Equipment	:	Reduction Clamps
		Retractors Specific to ORIF of Acetabular #
Implants	:	3.5 mm pelvic Reconstruction plates
		Cup with multiple holes
		Jumbo sized cups
		Autograft
		Acetabular cages

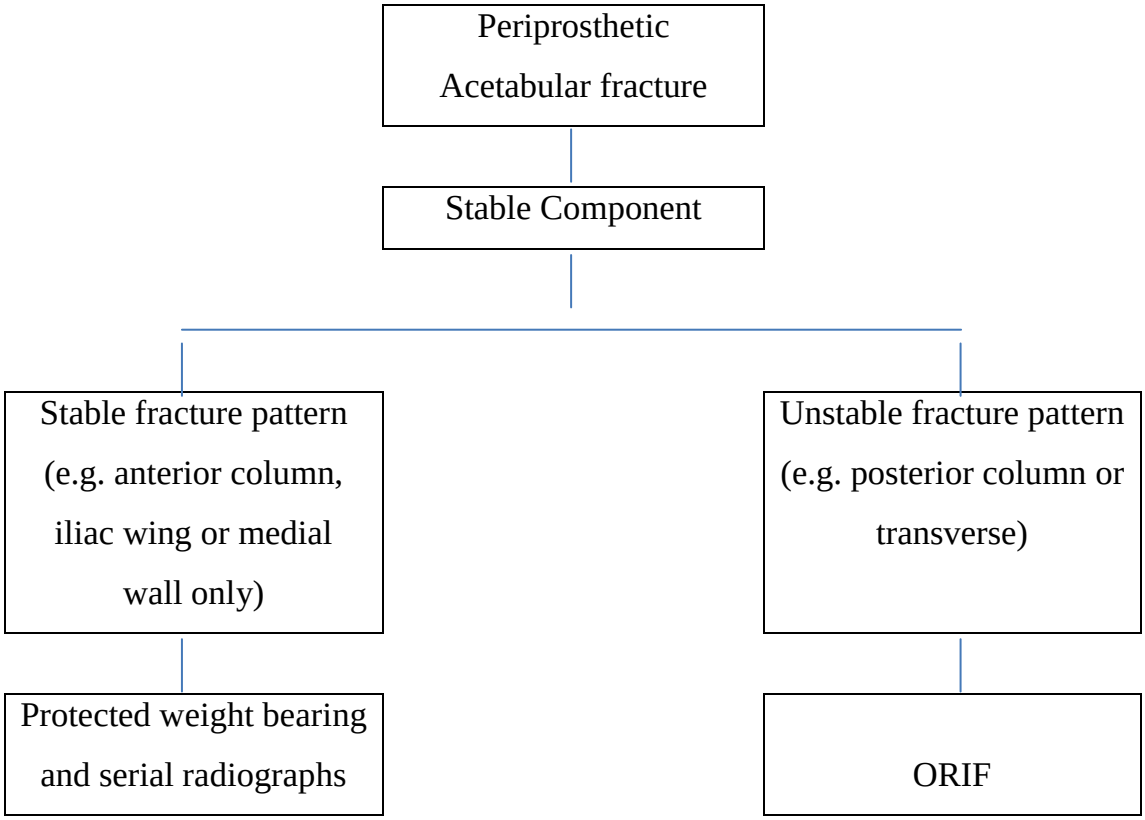
POTENTIAL PIT FALLS

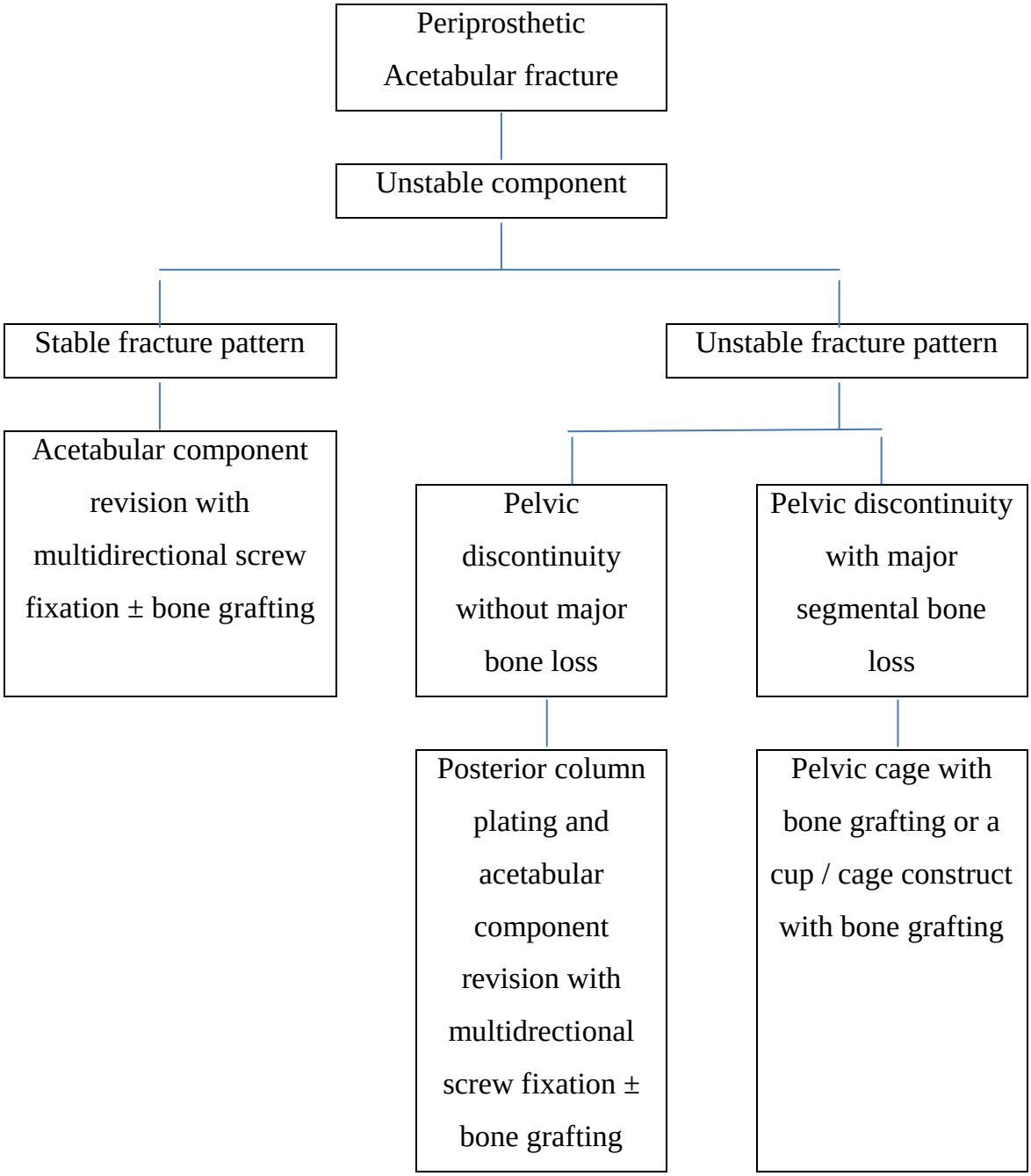
i. Cup instability

ii. Fracture mal-reduction or non union

iii. Missed intra- operative fractures

TREATMENT OPTIONS FOR ACETABULAR PERIPROSTHETIC FRACTURES




Periprosthetic Acetabular fracture
Unstable component
Stable fracture pattern
Unstable fracture pattern
Acetabular component revision with multidirectional screw fixation ± bone grafting
Pelvic discontinuity without major bone loss
Pelvic discontinuity with major segmental bone loss
Posterior column plating and acetabular component revision with multidirectional screw fixation ± bone grafting
Pelvic cage with bone grafting or a cup / cage construct with bone grafting

B. PERIPROSTHETIC FEMUR FRACTURES

Non-Operative treatment

INDICATIONS	RELATIVE CONTRAINDICATIONS
Stable femoral stem and non-displaced diaphyseal fractures	Loose implant
Proximal fractures related to osteolysis with adequate distal stem fixation	Proximal metaphyseal fractures with proximal fit stem
Non displaced Neck fractures associated with hip resurfacing	Displaced diaphyseal fractures
Minimally displaced trochanteric fractures	Widely displaced greater trochanter with altered abductor function

Pre-operative planning

Position	:	Lateral
	:	Array of reduction forceps
		Burr
		Saw
		Cable set
		Equipment for revision arthroplasty
Implants	:	Large Fragment Set
		Straight or burred plates
		Atleast 6 cables
		Femoral allograft strut
		Implants for revision arthroplasty
		Trochanteric claw plates

PITFALLS FOR ORIF OF PERIPROSTHETIC FEMORAL FRACTURES:

- Extensive Soft Tissue stripping.
- Mismatch between plate contour and bone.
- Inadequate proximal fragment fixation.
- Femoral stem is unexpectedly found to be loose.

PITFALL FOR REVISION ARTHROPLASTY

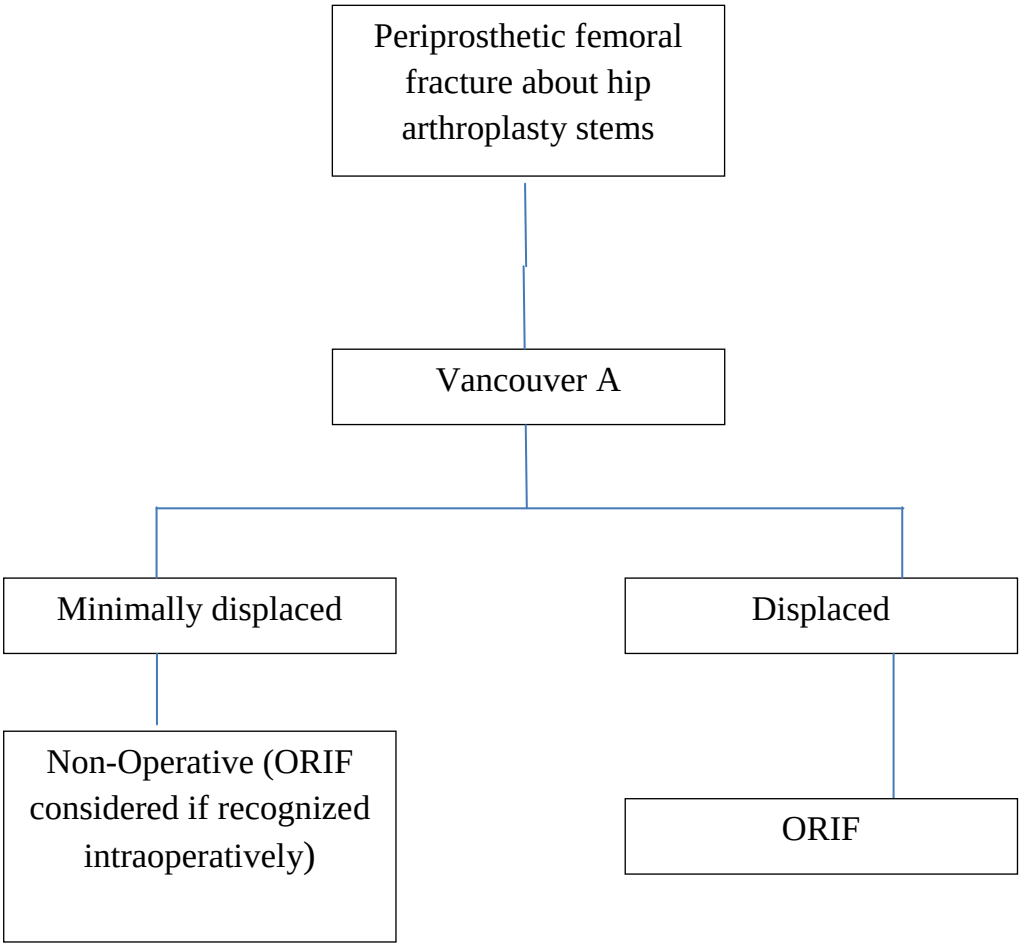
- Inadequate surgical field

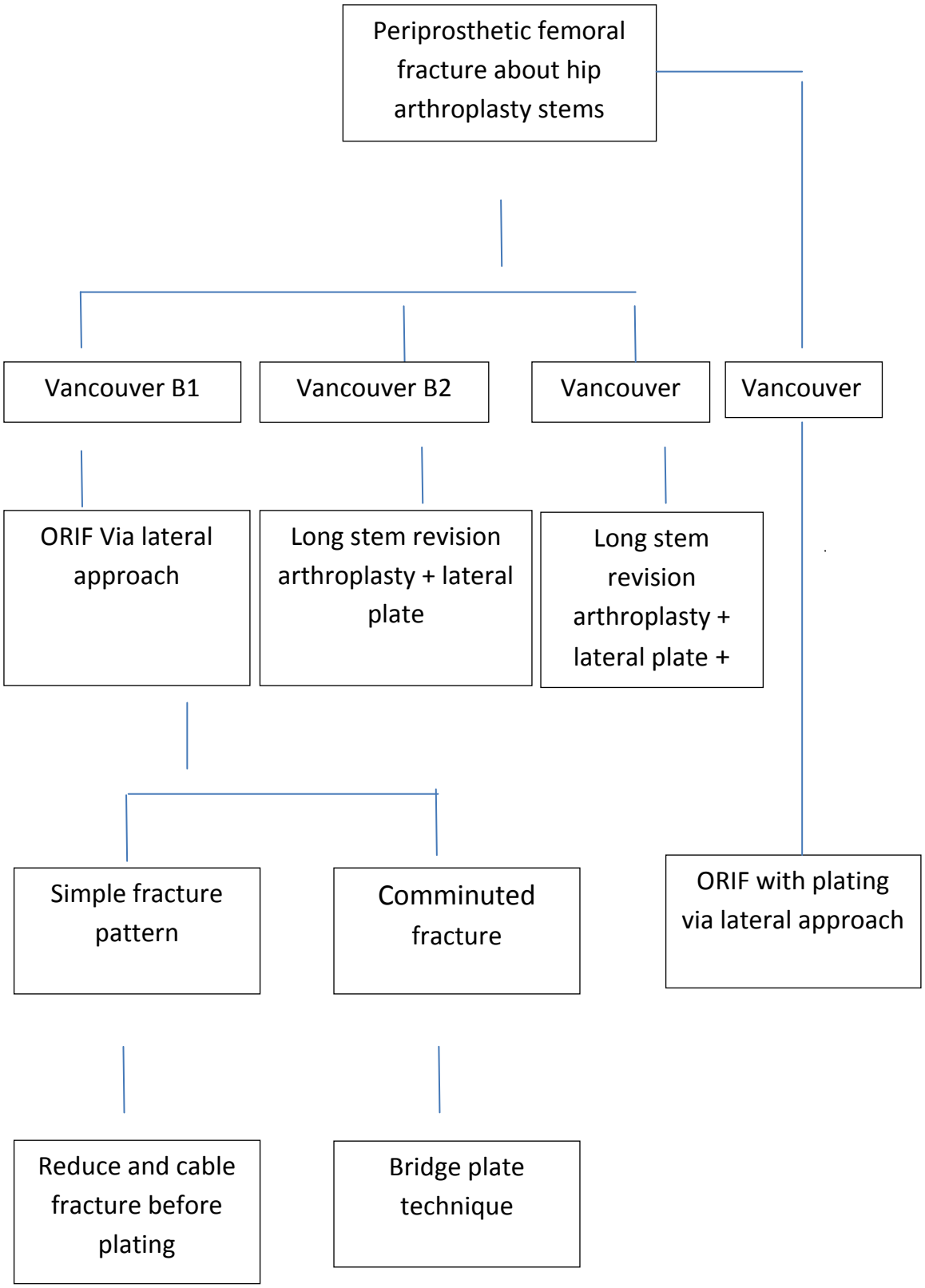
- Limited implant options

- Propagation of fracture distally

- Inadequate hip stability

VANCOUVER CLASSIFICATION SYSTEM AND TREATMENT OPTIONS FOR POSTOPERATIVE PERIPROSTHETIC FRACTURES




Periprosthetic femoral fracture about hip arthroplasty stems
Vancouver B1
Vancouver B2
Vancouver
Vancouver
ORIF Via lateral approach
Long stem revision arthroplasty + lateral plate
Long stem revision arthroplasty + lateral plate +
Simple fracture pattern
Comminuted fracture
ORIF with plating via lateral approach
Reduce and cable fracture before plating
Bridge plate technique

VANCOUVER CLASSIFICATION SYSTEM AND TREATMENT OPTIONS FOR INTRAOPERATIVE PERIPROSTHETIC FRACTURES

The treatment options for fractures occurring intra-operatively vary somewhat based on when the fracture was detected. Intra-operative identification, in general, leads to more surgical interventions than identification in the recovery room or later.

METAPHYSEAL FRACTURES

Classification	A1	A2	A3
Fracture Morphology	Cortical Perforation	Undisplaced Crack	Displaced or Unstable
Recognised fractures	Protected weight bearing or bone graft	Protected weight bearing or cerclage cables	ORIF with claw plate with conversion to long stem if implant unstable

DIAPHYSEAL FRACTURES

Classification	B1	B2	B3
Fracture Morphology	Cortical Perforation	Undisplaced Crack	Displaced or Unstable
Recognised fractures	Cortical strut with or without conversion to long stem implant	Lateral plate with conversion to long stem if implant unstable	Lateral plate with conversion to long stem if implant unstable

Fixation is with a lateral locked plate which is secured proximally with cables and then with locked screws into the trochanteric region. Distal fixation is with a combination of non locked and locked screws depending upon the bone quality. Lag screws are placed across the fracture through the plate whenever feasible. Entire length of the femur to be protected and therefore select a plate that extends at least to the distal metaphyseal flare. So, distal femoral locking plate was preferred. Comminuted fractures are treated similarly except a bridge plating technique is utilized.

FRACTURES DISTAL TO THE STEM

Classification	C1	C2	C3
Fracture Morphology	Cortical Perforation	Undisplaced Crack	Displaced or Unstable
Recognised fractures	Cortical Strut	Lateral plate	Lateral plate

Treatment is according to the techniques outlined for plate and screw placement of distal femur fractures. Here, lateral locking plate is utilized. Use plates long enough to overlap the femoral stem such that two cables can be placed that are spaced apart by 3 to 4 cm.

MANAGEMENT OF PERIPROSTHETC FRACTURE AFTER FEMORAL RESURFACING PROSTHESIS

Non-operative management is often cited as a viable treatment option for non displaced femoral neck fractures associated with hip resurfacing.

There is little role for internal fixation of these fractures after femoral resurfacing, although successful plate and screw fixation and intramedullary nailing has been reported for the management of intertrochanteric and subtrochanteric fractures in the setting of hip resurfacing.

- **NON OPERATIVE MANAGEMENT**

Viable treatment option for non displaced femoral neck fractures associated with hip resurfacing.

- **OPERATIVE MANAGEMENT**

Completely displaced fractures or those with components that have shifted are generally treated with Revision Arthroplasty.

POST OPERATIVE CARE

- Therapy for knee ROM, transfer training and use of assist devices are initiated in immediate post operative period.
- Protected weight bearing for 6-8 weeks.
- Based on progressive clinical and radiographic signs of fracture healing, weight bearing gradually advanced.
- Full weight bearing is typically accomplished by 6-8 weeks and at this time formal strengthening and gait training therapy are useful.

COMPLICATIONS

- Painful bursitis.
- Non union.
- Implant failure.
- Infection.
- Refracture.

PREVENTION

- **POST-OPERATIVE PERIPROSTHETIC FRACTURES**

Prevention is far better than the most advanced method of cure in these fractures. Early component loosening with or without osteolysis is often asymptomatic, emphasizes the need for routine for patients with THA. This preventive approach is more cost effective than the high costs of the management of these fractures.

- **INTRA-OPERATIVE PERIPROSTHETIC FRACTURES**

Common orthopaedic sense should prevail but the following pearls could prevent at least intra-operative fractures.

- Adequate exposure and soft tissue release should be performed prior to hip dislocation.
- Adequate reaming should be completed before the template prosthesis is inserted using the piriformis as the entry point.
- In revision surgery, it is important to split intramedullary cement radially before attempting to remove it.
- When making cortical windows, great care should be taken to prevent sharp corners that could propagate in fracture lines. These windows should be bypassed by at least two femoral diameters of stem.

AIM

To assess the functional and radiological outcome of patients who underwent treatment for periprosthetic fracture following primary hip arthroplasty.

MATERIALS AND METHODS

Study design:

Prospective and Retrospective study.

Study population:

It comprised of cases admitted in Government Kilpauk Medical College and Hospital in the Department of Orthopaedics. Because of low incidence of this type of fracture in our institution, we also included cases done outside elsewhere and came to us for follow up.

Duration of study:

- 12 months.

Follow up interval:

- Every 6 weeks, 3 months, 6 months & 1 year.
- Total No. of cases which met inclusion criteria done between 2016 may and 2018 september-23 cases.
- 4 cases were lost in follow-up.
- 4 patients died during follow-up.

Total No. of cases in this study: 15 patients.

INCLUSION CRITERIA

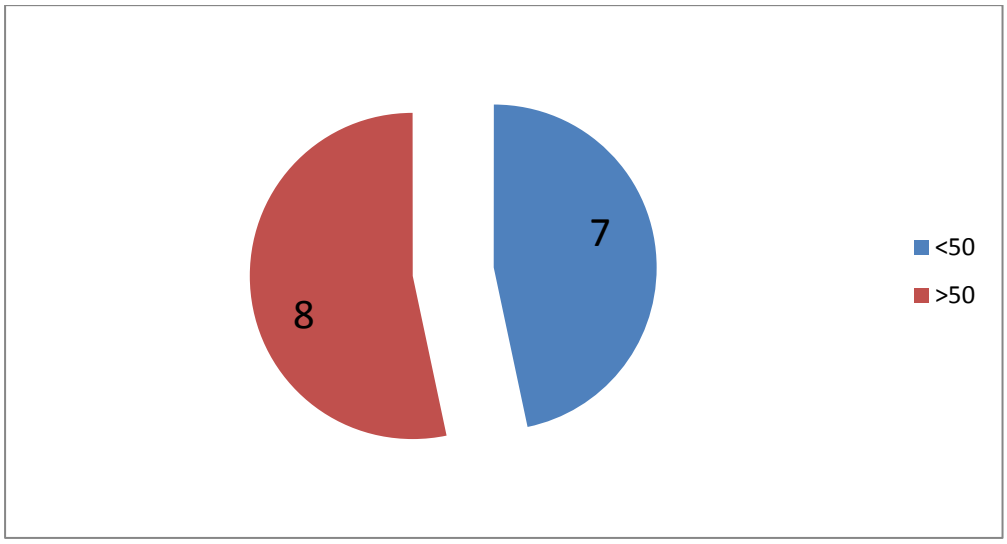
- Patients who underwent treatment for periprosthetic fracture following primary hip arthroplasty including total hip arthroplasty and hemiarthroplasty.
- Age > 18 years.

EXCLUSION CRITERIA

- Periprosthetic fracture following Revision THR.
- Age <18 years.
- Medically unfit patients.

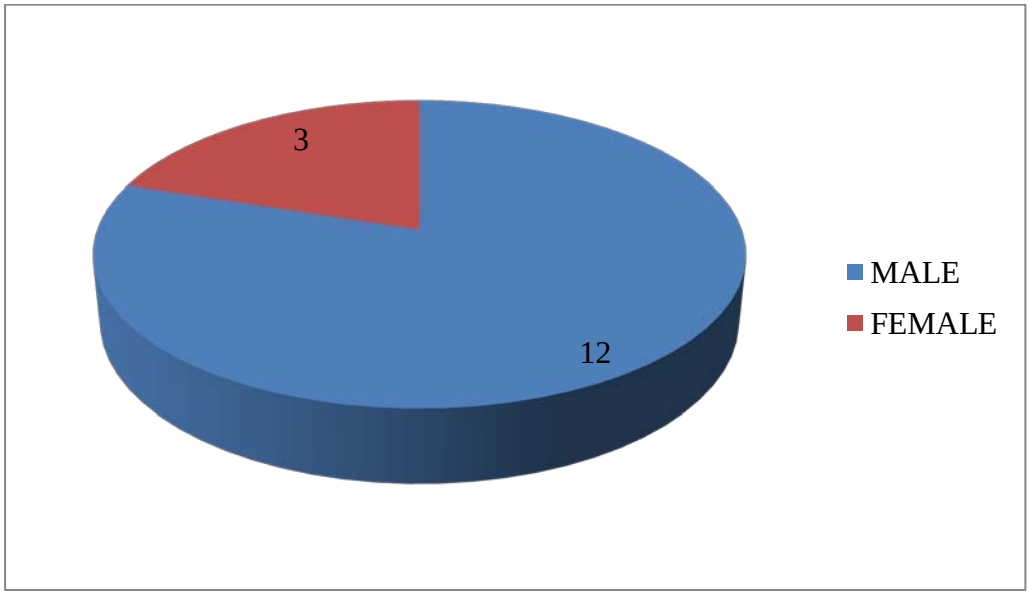
RESULTS

AGE DISTRIBUTION



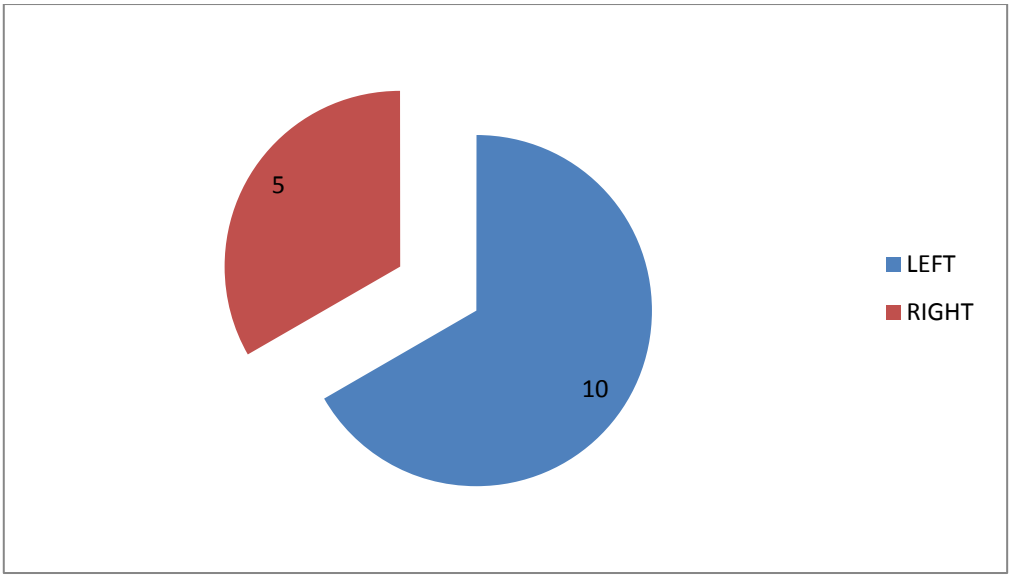
This study consists of totally, 15 patients. Out of which, 8 patients were more than 50 yrs and 7 patients were less than 50 yrs.

SEX DISTRIBUTION



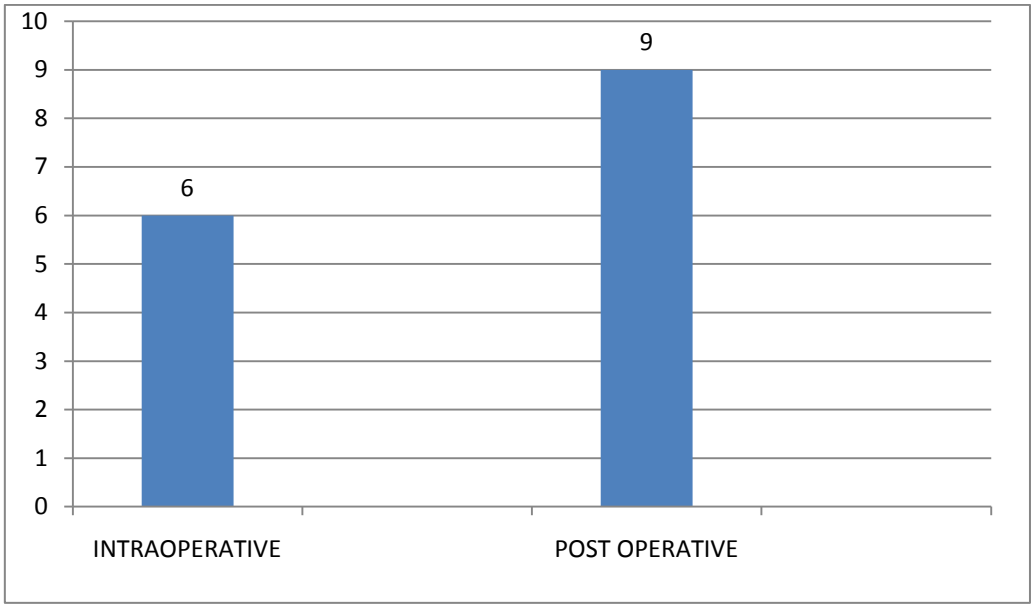
In this study, totally there were 15 patients. Out of which, 12 patients were male and 3 patients were female.

SIDE DISTRIBUTION



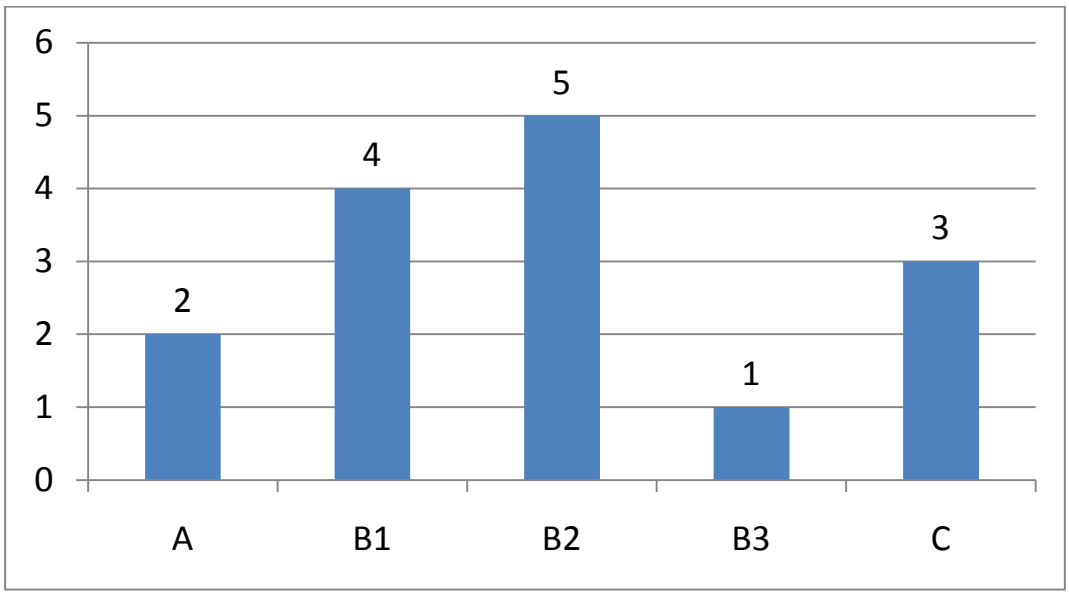
Among 15 patients of periprosthetic fractures of hip, 10 patients were right sided and 5 patients were left sided.

TIME OF FRACTURE



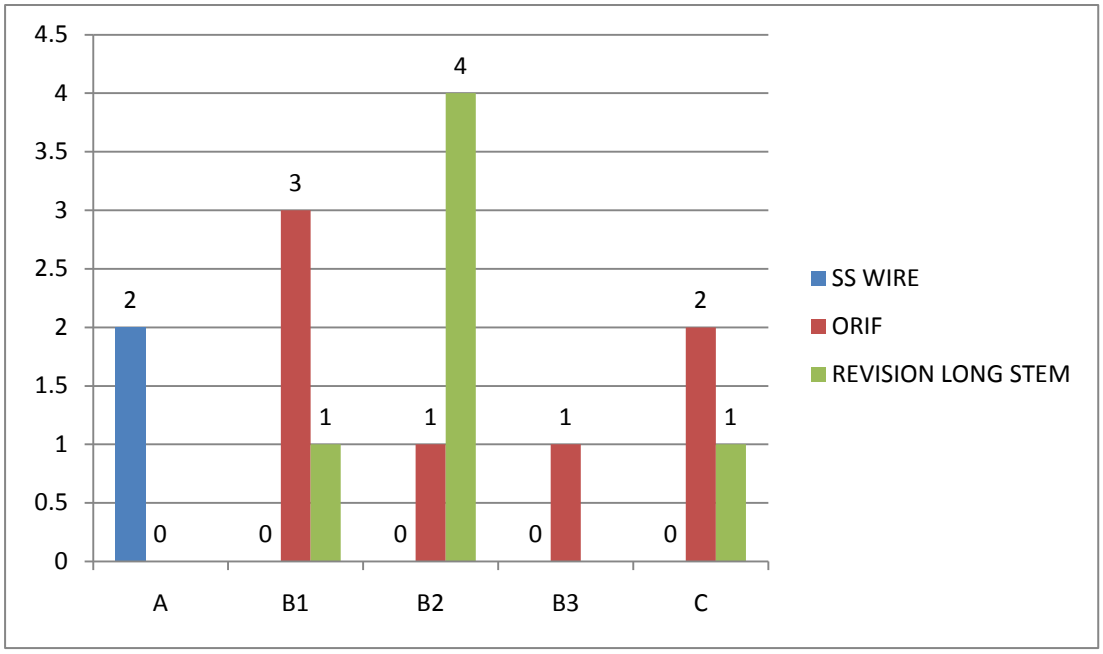
In this study, out of 15 periprosthetic fractures, 9 fractures occurred post-operatively and 6 occured intra-operatively during surgery.

CLASSIFICATION



In this study, there were 2 patients under type A fractures, 4 patients under type B1group, 5 patients under type B2, One under type B3 and 3 patients under type C fracture.

NO OF PATIENTS

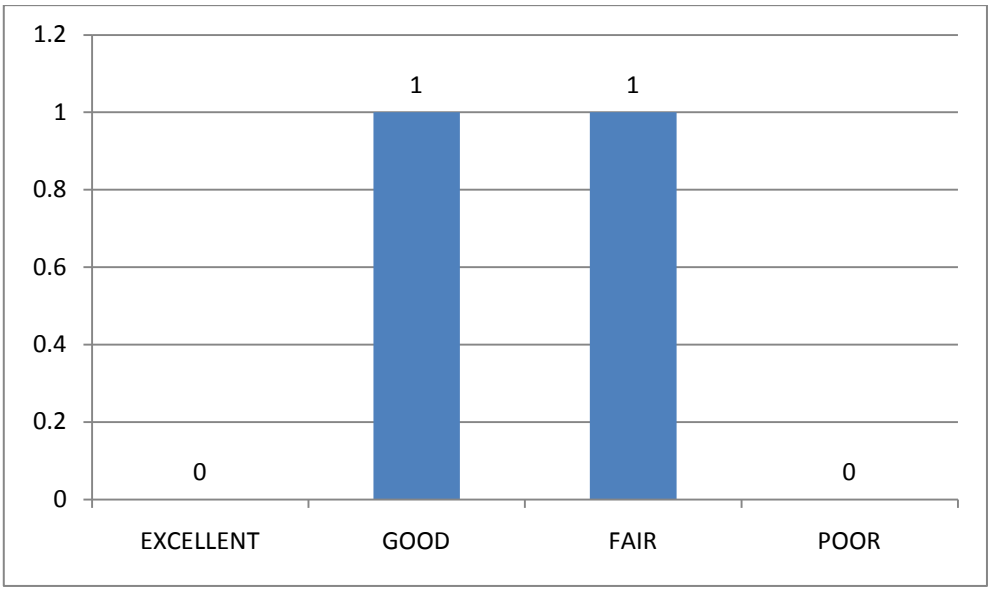


Out of 15 patients, there were 2 patients under TYPE A fractures, 4 patients under TYPE B1 fractures, 5 patients under TYPE B2 fractures, ONE patients under TYPE B3 fractures and 3 patients under TYPE C fractures .

Out of 15 patients, 2 patients were treated with SS wire, 7 patients were treated with ORIF WITH PLATING and 6 patients were treated with Revision long stem.

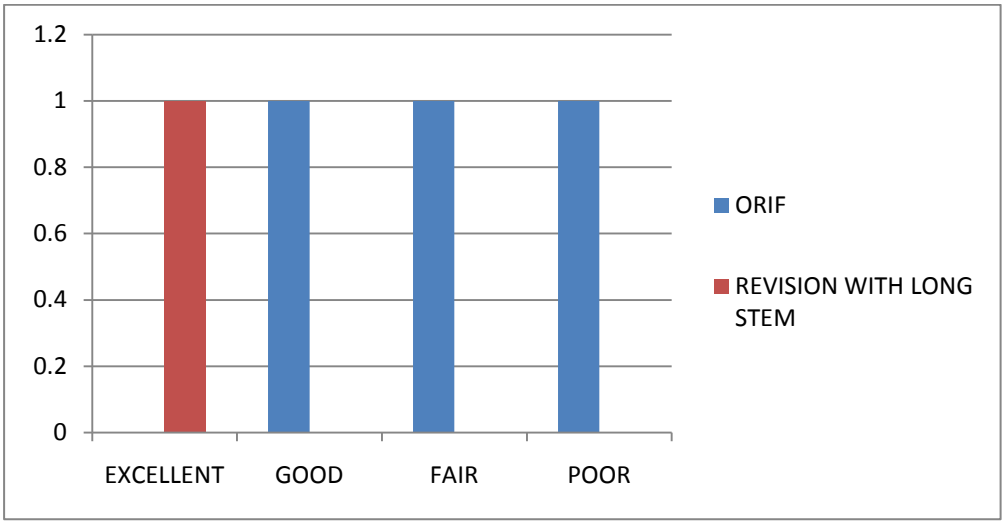
FUNCTIONAL OUTCOME

TYPE A FRACTURES TREATED WITH SS WIRE



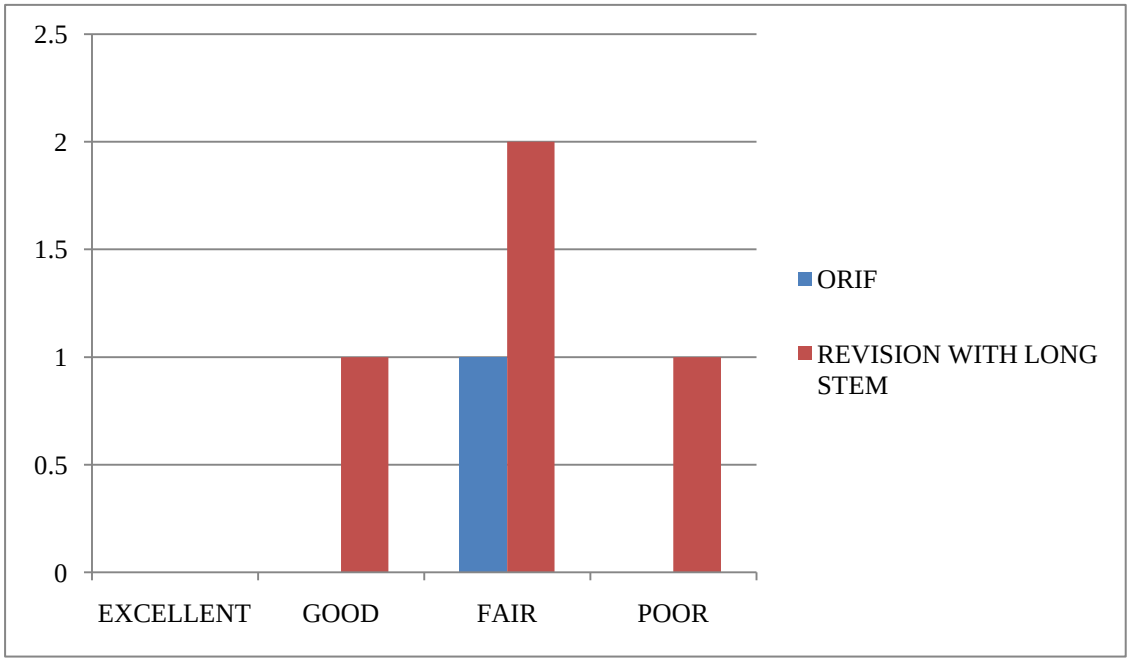
Under TYPE A fractures, there were 2 patients who underwent treatment with SS wire. One had good outcome and other had fair outcomes.

TYPE B1 FRACTURES



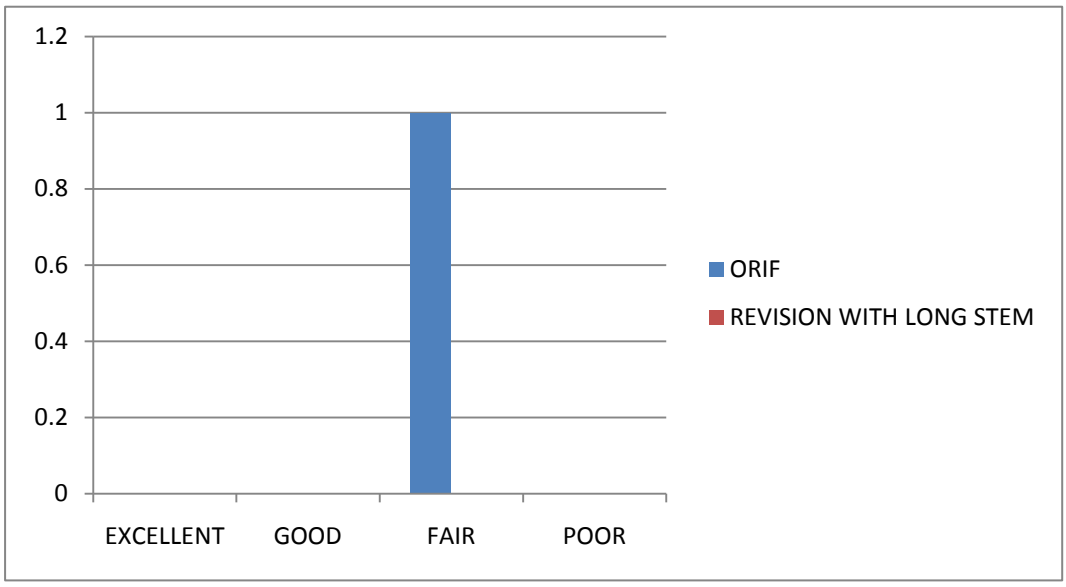
Under TYPE B1 fractures, there are 4 patients. Among which, 3 patients underwent treatment with ORIF WITH PLATING. One who underwent treatment with Revision long stem had excellent outcome.

TYPE B2 FRACTURES



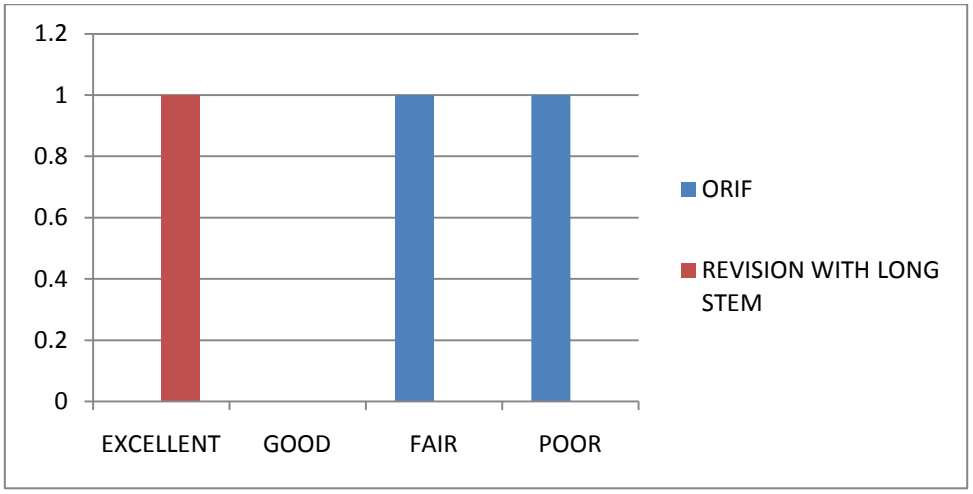
Under TYPE B2 fractures, there were 5 patients. Among them, 4 underwent treatment with Revision long stem. One had good, One had poor and two had fair outcome. 1 patient is treated with ORIF showed fair outcomes.

TYPE B3 FRACTURES TREATED WITH ORIF



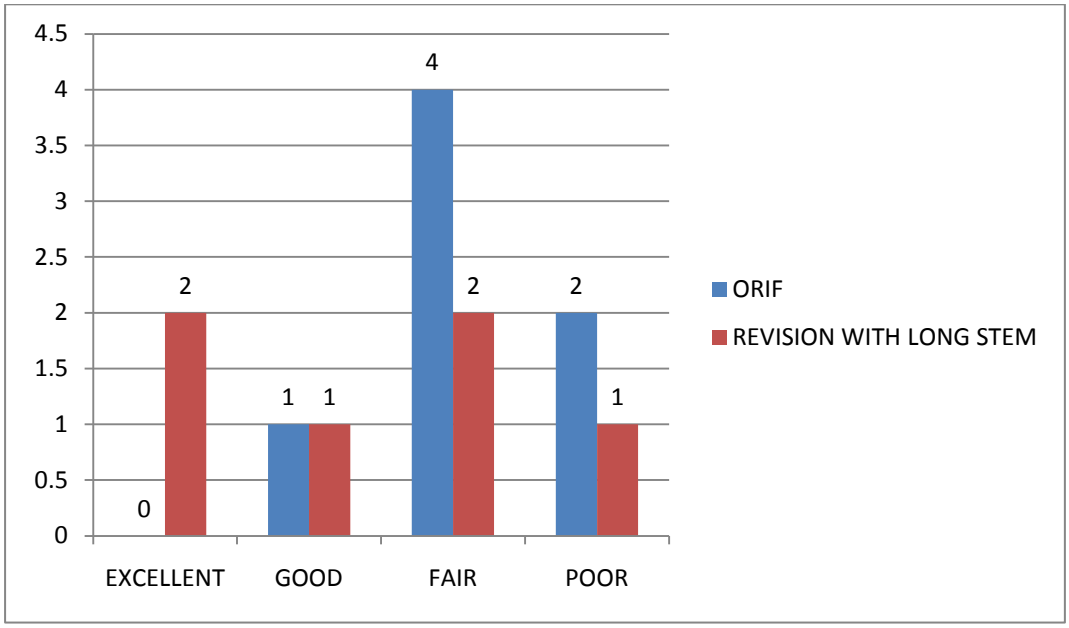
Under TYPE B3 fractures, there is one patient. Who was treated with ORIF showed fair outcomes.

TYPE C FRACTURES



Under TYPE C fractures, there were 3 patients. Among them, One patient underwent treatment with Revision long stem showed excellent outcome. 2 patients were treated with ORIF showed fair and poor outcomes.

ORIF VS REVISION WITH LONG STEM



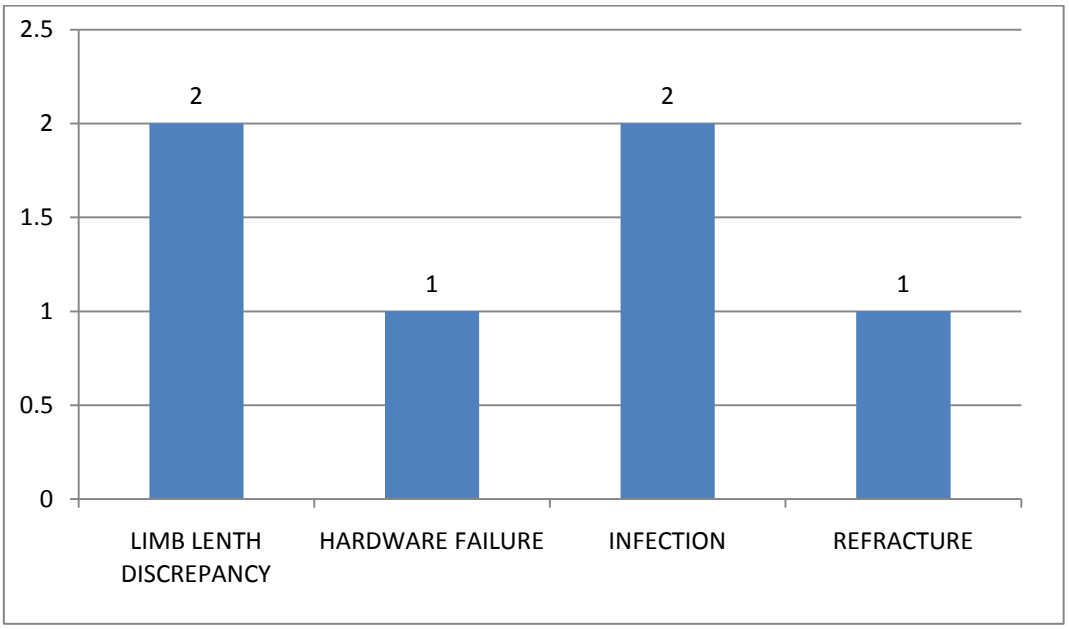
In this study out of 15 patients, 7 patients were treated with ORIF WITH PLATING and 6 patients were treated with REVISION LONG STEM. Among 7 patients treated with ORIF, one showed good outcome, 4 showed fair outcomes and 2 showed poor outcomes. Among 6 patients treated with REVISION LONG STEM, one showed good outcome, 2 showed fair outcomes and one showed poor outcome.

COMPLICATIONS

OVERALL

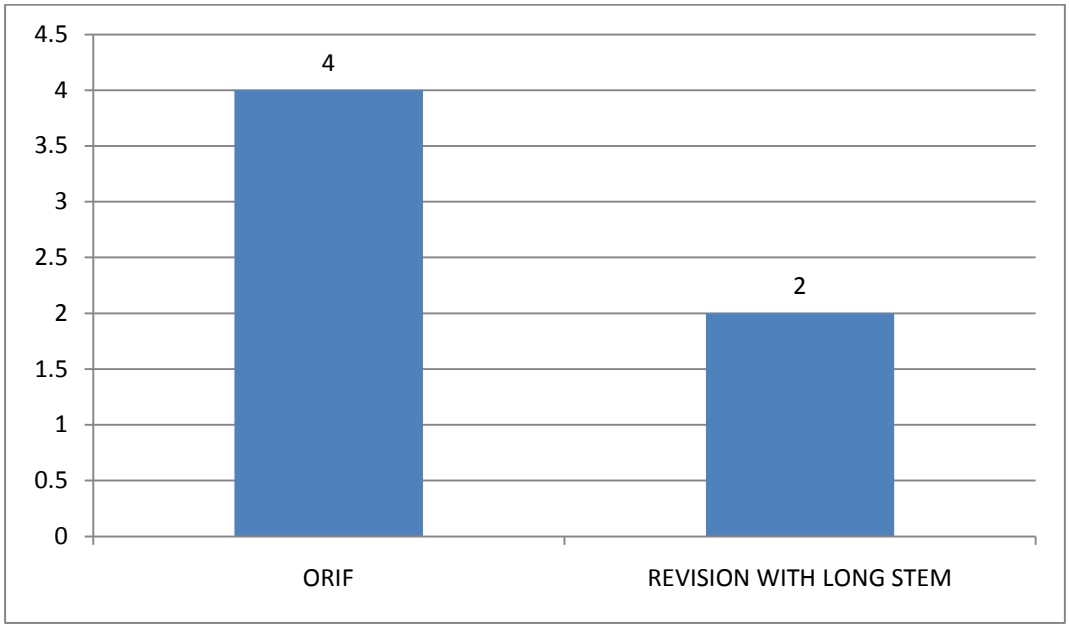
It includes

- Hard ware failure.
- Limb length discrepancy.
- Infection.
- Refracture.



In this study out of 15 patients, who were treated with SS wire, ORIF WITH PLATING and REVISION LONG STEM. Limb length discrepancy seen in 2 patients. Hardware failure seen in one case. Infection in 2 cases and Refracture in one case.

ORIF VS REVISION WITH LONG STEM



In this study out of 15 patients, 7 patients were treated with ORIF WITH PLATING and 6 patients were treated with REVISION LONG STEM and 2 patients with SS wire. Among 15 patients, complications seen in 4 patients treated with ORIF and 2 patients treated with REVISION LONG STEM.

Pre-operative Clinical Assessment

The general condition of the patient including patient's physical, mental status, general medical condition and ability to withstand surgery were considered.

Pre-operative Investigations

Complete blood picture, ASO titer, CRP, RA Factor, urine analysis, chest x-ray – PA view and ECG were done as a routine.

Pre-operative radiographic assessment

- X ray Pelvis with both hips AP view.
- X ray of affected hip with Femur AP view and Lateral view.

Surgical Approach

In this study, all cases were operated through Postero-lateral approach / Lateral approach (HARDINGE'S APPROACH).

Post-operative protocol

1. Antibiotics - 3rd generation Cephalosporin's and Aminoglycosides. I.V Antibiotics for 5 days followed by oral antibiotics for 5 days.

2. Anti DVT prophylaxis.

3. Injection Teriparatide for old and osteoporotic patients.

4. Drain removal done preferably on the 2nd POD. Delayed if the drain is more than 100ml.

5. In bed mobilization was taught and chest physiotherapy was done to all patients on 1st post operative day.

Mobilization

All patients started on non weight bearing walking with walker support on 2nd post operative day. Full /partial weight bearing walking after 6 weeks post operatively with X-rays showing signs of fracture healing.

Post-operative Evaluation

Clinical evaluation was done with Harris hip score. During post operative follow up, x-ray of the operated hip including AP view and Lateral view were done for all patients at regular intervals.

Harris Hip Score

Hip ID:

Study Hip: ☐ Left ☐ Right

Examination Date (MM/DD/YY): / /

Subject Initials: |____|____|____|

Medical Record Number:

Interval: _____

Harris Hip Score

Pain *(check one)*

- ☐ None or ignores it (44)
- ☐ Slight, occasional, no compromise in activities (40)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- ☐ Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bed, bedridden (0)

Limp

- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support

- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches or not able to walk (0)

Distance Walked

- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoors only (2)
- ☐ Bed and chair only (0)

Sitting

- ☐ Comfortably in ordinary chair for one hour (5)
- ☐ On a high chair for 30 minutes (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation

- ☐ Yes (1)
- ☐ No (0)

Stairs

- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on Shoes and Socks

- ☐ With ease (4)
- ☐ With difficulty (2)
- ☐ Unable (0)

Absence of Deformity (All yes = 4; Less than 4 =0)

Less than 30° fixed flexion contracture	☐ Yes	☐ No
Less than 10° fixed abduction	☐ Yes	☐ No
Less than 10° fixed internal rotation in extension	☐ Yes	☐ No
Limb length discrepancy less than 3.2 cm	☐ Yes	☐ No

Range of Motion (**indicates normal*)

- Flexion (*140°) _____
- Abduction (*40°) _____
- Adduction (*40°) _____
- External Rotation (*40°) _____
- Internal Rotation (*40°) _____

Range of Motion Scale

211° - 300° (5)	61° - 100 (2)
161° - 210° (4)	31° - 60° (1)
101° - 160° (3)	0° - 30° (0)

Range of Motion Score _____

Total Harris Hip Score _____

CASE DISCUSSION

CASE 1

Name : Mr. O.

Age : 44.

Primary surgery : UNCEMENTED TOTAL HIP REPLACEMENT RIGHT HIP.

Diagnosis : Type B1 periprosthetic fracture right hip.

Surgery done : ORIF WITH PLATING AND SS WIRE.

Pre-op

Pod 1

3 month follow up

6 month follow up

One year follow up

CLINICAL PICTURES

HARRIS HIP SCORE- 88

GOOD

CASE 2

Name: Mr. K.

Age : 18.

Primary surgery : BILATERAL THR

Diagnosis : ASEPTIC LOOSENING with INTRAOPERATIVE TYPE B2 periprosthetic fracture left femur.

Secondary surgery : Revision with long stem and SS wire augmentation.

Pre-op

Immediate Post-op

6 month follow up

One year follow up

CLINICAL PICTURES

HARRIS HIP SCORE - 70

FAIR

CASE 3

Name: Mr. L.

Age : 40.

Primary diagnosis : NON UNION NECK OF FEMUR fracture with CANCELLOUS SCREW INSITU right hip

Intra operative : TYPE A fracture

Procedure done : THR with SS wire right

Pre-op

Immediate post-op

One year follow up

HARRIS HIP SCORE-78

FAIR

CLINICAL PICTURES

Case 4 -Complication

Name: Mr. H.

Age : 52.

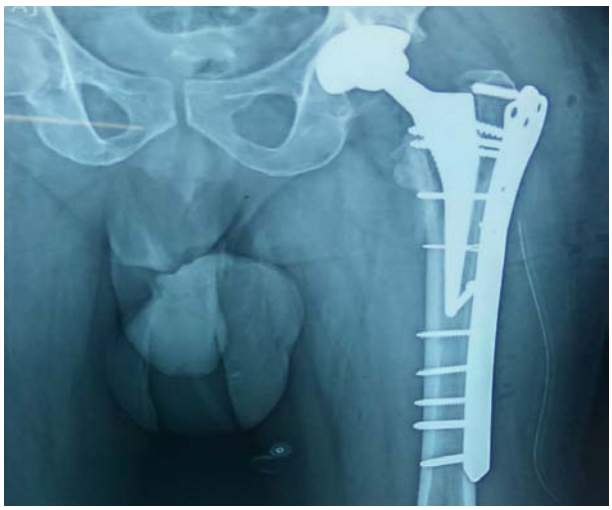
Primary surgery : UNCEMENTED THR right hip.

Diagnosis : Type B1 periprosthetic fracture right.

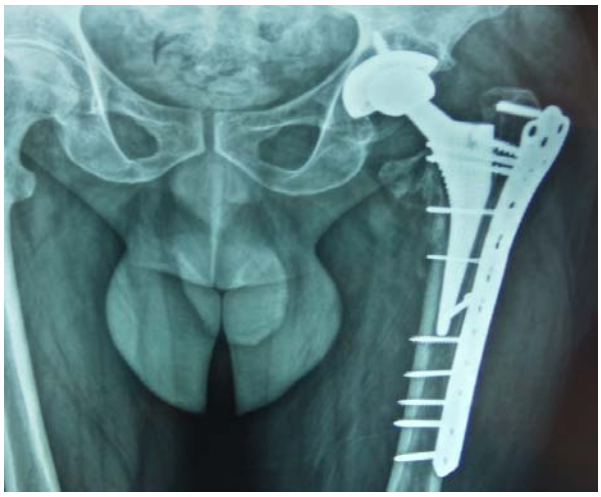
Secondary surgery : ORIF with PLATING.

Pre-op

Immediate post-op



6 Month Follow Up



- Patient complains of severe pain and not able to carry out routine day to day activities.Follow up x ray shows hardware failure and susidence of prosthesis.

HARRIS HIP SCORE-20

POOR

- Later plate removed and revised with long stem.

Immediate Post-op

2 month follow up

6 month follow up

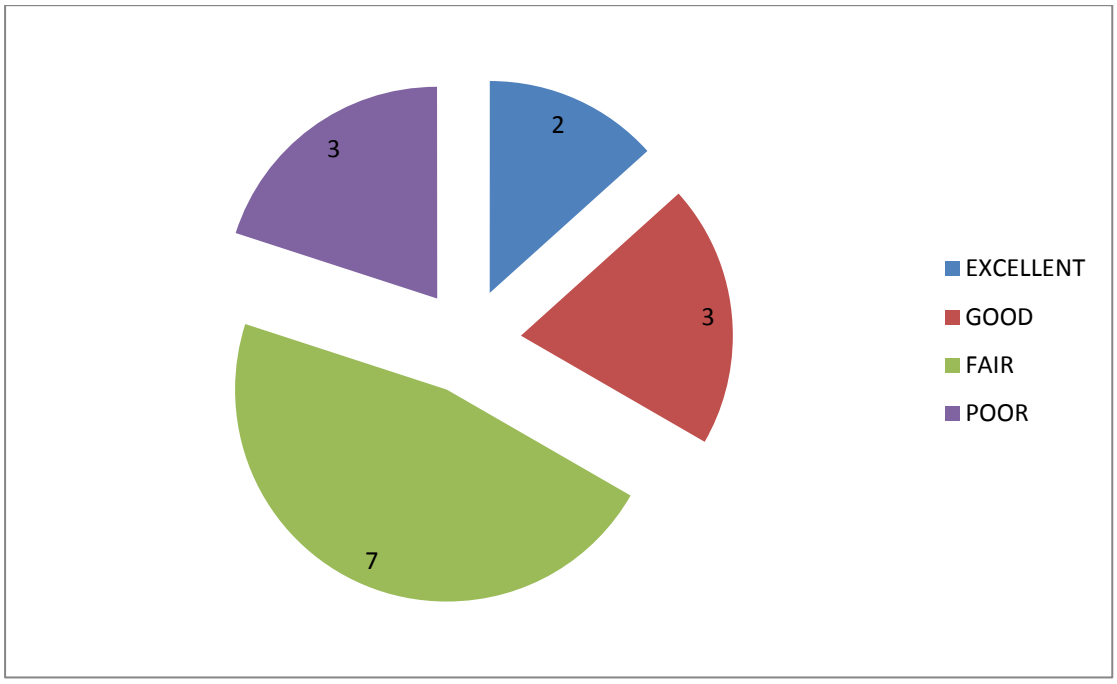
Clinical pictures

RESULTS

- Clinical evaluation using Harris Hip Score revealed the following

Harris Hip Score - Results

Excellent	2 cases	13.33%
Good	3 cases	20%
Fair	7 cases	46.66%
Poor	3 case	20%



Limb length discrepancy

- Limb shortening is seen in 2 cases (33.33%).

- 3 cases of limb length discrepancy Corrected using heel rise.

Hardware failure

- Hardware failure seen in one case (16.6%).

- Patient underwent revision with long stem.

Infection

- Infection seen in 2 cases (33.33%).

- Patient investigated with ESR, CRP AND PUS CULTURE AND SENSITIVITY.

- Patient treated with culture specific antibiotics.

Refracture

- Refracture seen in one case (16.6%).

- Treated with ORIF with PLATING.

DISCUSSION

Periprosthetic fracture of the femur after hip arthroplasty is a difficult treatment challenge. The rate of periprosthetic fracture associated with THA is increasing due to increased rate of primary THA[35]. The results of management of periprosthetic fractures have varied greatly due to factors such as bone quality, fracture pattern and method of treatment including non operative measures, plating or revision surgery.

Periprosthetic fractures can occur both intra operatively and post operatively. The rate of post-operative fractures is high. In this study of 15 patients, there were 9 post-operative fractures (60%) and 6 intra operative fracture (40%).

The goals of surgical treatment are to achieve:

- Early union.
- Anatomical alignment and length.
- A stable prosthesis.
- Early mobilisation.
- Return to pre-morbid function.
- Maintenance of adequate bone stock.

The most widely used methods of fixation are

- Cerclage fixation using SS wire or CABLE wire.
- Revision THR with long stem with or without long stem.
- ORIF with PLATING.
- Cortical strut grafts[36.]

This study consists of 15 patients with periprosthetic fracture including both intra operative and post operative fractures, 12 male (80%) and 3 female (20%).

Fractures were classified according to Vancouver classification[37] and results were assessed by Harris Hip Score.

Bryan D. Springer, Daniel et al (JJBJS VOLUME 85-A.NUMBER 11 NOV2013) study evaluated 118 cases who underwent revision THR for periprosthetic fracture (type B) of which 16 patient underwent revision of femoral stem due to loosening, fracture nonunion, recurrent dislocation, new periprosthetic fracture.

Nikola Bulatovic, Miroslav Kezunovic et al (Acta Clin Croat, Vol, 56 NO.3, 2017) study evaluated periprosthetic fractures in 23 patients. Out of all Vancouver type B fractures, 2 patients had infection, 5 patients had hardware failure, one patient had new periprosthetic fracture and one patient showed loosening of stem.

In this study of 15 cases, there were 2 revised surgeries done in one year follow up, one due to refracture and other due to hardware failure. Infection was seen in one case. There was no evidence of stem loosening, dislocation or non union.

Type A

In this study, there were 2 TYPE A (13.33%) fracture who underwent treatment with SS wire. One had good outcome and other had fair outcome.

Type B1 Fracture

In this study, 4 patients (26.66%) had type B1 fracture.

- 1 Patient was treated with Revision Long Stem.

  -This patient showed excellent outcome.

- 3 Patients were treated by ORIF with PLATING.

  -In this group, one patient had hardware failure in the follow-up period and underwent plate removal and revision with long stem.

Type B2 Fracture

In this study, there were 5 patients (33.33%) with Type B2 fracture.

- One patient underwent ORIF with PLATING and other 4 underwent REVISION WITH LONG STEM.
- Harris Hip Score was fair in the patient who underwent treatment with PLATING.
- Among 4 patients, who were treated with REVISION LONG STEM, Harris Hip Score was good in one patient, fair in 2 patients and one showed poor outcome due to infection.

Type B3 fracture

In this study, we had one patient (6.66%) under type B3 fracture.

- This patient was treated by ORIF with PLATING and patient showed fair outcome.

Type C Fracture

In this study, there were 3 patients (20%) who had Type C fracture. One patient had excellent result with REVISION LONG STEM and the other 2 patients who were treated by ORIF with PLATING showed fair and poor outcomes.

The patients with poor HARRIS HIP SCORE had refracture due to stress riser effect and again revised with plating. Finally, patient had developed shortening of 0.5cm and was given heel rise foot wear.

This study shows

- Risk of failure with plate fixation was high in type B fractures.
- Long stem showed better outcome in type B1 and type B2 fractures.
- Risk of failure was significantly reduced using Revision long stem.
- Functional outcome is better with revision long stem when compared to plate fixation.
- In type C fractures, plate fixation shows fair results.

CONCLUSION

This study demonstrates excellent to good success rate in treating the majority of periprosthetic fracture. However, there are few complications such as refracture, infection and hardware failure.

Vancouver classification provides excellent information about the fracture pattern and helps in pre operative planning and choice of treatment.

Revision with long stem for the treatment of periprosthetic fracture showed good results in most of the cases when compared with plating alone in B TYPE fractures. Treating TYPE C fractures with plate osteosynthesis showed fair results.

The prevention of periprosthetic fractures remains the best strategy. Regular follow up of THAs allows identification of patients with osteolysis and component loosening who are at risk of fracture and is likely cost effective.

The limitation of this study includes small number of cases and short follow up.

Injection Teriparatide helps in union and good functional outcome, used in indicated cases.

BIBLIOGRAPHY

1. Michael Schütz | Carsten Perka Senior Editor Thomas P Rüedi: Periprosthetic Fracture Management, AO-TRAUMA, page no3: 2013.

2. Phillips JR, Boulton C, Morac CG, et al. What is the financial cost of treating periprosthetic hip fractures? Injury. 2011 Feb; 42 (2):146–149.

3. William M.Rucci, Charles M. Court-Brown, James D. Heckman, Margaret M. McQueen, Rockwood and Green's Fractures in Adults, Periprosthetic fractures, EIGHTH edition, chapter 23, page no692.

4. Haddad FS, Masri BA, Garbuz DS, et al. The prevention of periprosthetic fractures in total hip and knee arthroplasty. Orthop Clin North Am. 1999 Apr; 30(2):191–207. [8].

5. Learmonth ID. The management of periprosthetic fractures around the femoral stem. J Bone Joint Surg Br. 2004 Jan; 86(1):13–19.

6. Lindahl H, Malchau H, Herberts P, et al. Periprosthetic femoral fractures classification and demographics of 1049 periprosthetic femoral fractures from the Swedish National Hip Arthroplasty Register. J Arthroplasty. 2005 Oct; 20(7):857–865.

7. Kolstad K. Revision THR after periprosthetic femoral fractures. An analysis of 23 cases. Acta Orthop Scand. 1994;65(5):505–508.

8. Lewallen DG, Berry DJ. Periprosthetic fracture of the femur after total hip arthroplasty: Treatment and results to date. Instr Course Lect. 1998;47:243–249.

9. Ricci WM, Borrelli J Jr. Operative management of periprosthetic femur fractures in the elderly using biological fracture reduction and fixation techniques. Injury. 2007;38(suppl 3):S53–S58.

10. Ricci WM, Haidukewych GJ. Periprosthetic femoral fractures. Instr Course Lect. 2009; 58: 105–115. 230.

11. Ricci WM, Loftus T, Cox C, et al Locked plates combined with minimally invasive insertion technique for the treatment of periprosthetic supracondylar femur fractures above a total knee arthroplasty. J Orthop Trauma. 2006;20(3):190–196.

12. Park MS, Lim YJ, Chung WC, et al. Management of periprosthetic femur fractures treated with distal fixation using a modular femoral stem using an anterolateral approach. J Arthroplasty. 2009 Dec; 24(8):1270– 1276.

13. Cook RE, Jenkins PJ, Walmsley PJ, et al. Risk factors for periprosthetic fractures of the hip: a survivorship analysis. Clin Orthop Relat Res. 2008 Jul; 466(7):1652–1656.

14. Langenhan R, Trobisch P, Ricart P, et al. Aggressive surgical treatment of periprosthetic femur fractures can reduce mortality: Comparison of

open reduction and internal fixation versus a modular prosthesis nail. J Orthop Trauma. 2012; 26(2):80–85.

15. Laurer HL, Wutzler S, Possner S, et al. Outcome after operative treatment of Vancouver type B1 and C periprosthetic femoral fractures: Open reduction and internal fixation versus revision arthroplasty. Arch Orthop Trauma Surg. 2011;131(7):983–989.
16. Pavlou G, Panteliadis P, Macdonald D, et al. A review of 202 periprosthetic fractures–stem revision and allograft improves outcome for type B fractures. Hip Int. 2011;21(1):21–29.
17. Horwitz IB, Lenobel MI. Artificial hip prosthesis in acute and nonunion fractures of the femoral neck: follow-up study of seventy cases. J Am Med Assoc 155(6): 564, 1954.
18. Parrish TF, Jones JR. Fracture of the Femur Following Prosthetic Arthroplasty of the Hip. Report of Nine Cases. J Bone Joint Surg Am 46: 241, 1964.
19. Whittaker RP, Sotos LN, Ralston EL**.** Fractures of the femur about femoral endoprostheses. J Trauma 14(8): 675, 1974.
20. Lindahl H, Garellick G, Regner H, Herberts P, Malchau H. Three hundred and twenty-one periprosthetic femoral fractures. J Bone Joint Surg Am 88(6): 1215, 2006.

21. Frederick M.Azar, James H.Beaty, S.Terry Canale, campbell' s operative orthopaedics 13th edition, chapter 3,page no167.

22. Wang JW, Wang CJ (2000) Periprosthetic fracture of the femur after hip arthroplasty: the clinical outcome using cortical strut allografts. J Orthop Surg (Hong Kong) 8(1):27–31.

23. McElfresh EC, Coventry MB. Femoral and pelvic fractures after total hip arthroplasty. J Bone Joint Surg Am. 1974 Apr;56(3):483–492.

24. Morrey BF, Kavanagh BF. Complications with revision of the femoral component of total hip arthroplasty. Comparison between cemented and uncemented techniques. J Arthroplasty. 1992 Mar; 7(1):71–79.

25. Berry DJ, Lewallen DG, Hanssen AD, et al. Pelvic discontinuity in revision total hip arthroplasty. J Bone Joint Surg Am. 1999 Dec;81(12):1692–1702.

26. Franklin J, Malchau H. Risk factors for periprosthetic femoral fracture. Injury. 2007;38 (6): 655–660.

27. Kumar S, Sperling JW, Haidukewych GH, et al. Periprosthetic humeral fractures after shoulder arthroplasty. J Bone Joint Surg Am. 2004;86-A(4):680–689.

28. Ricci WM, Haidukewych GJ. Periprosthetic femoral fractures. Instr Course Lect. 2009;58: 105–115.

29. Beals RK, Tower SS. Periprosthetic fractures of the femur. An analysis of 93 fractures. Clin Orthop. 1996;(327):238–246.

30. Hardy DC, Delince PE, Yasik E, et al. Stress fracture of the hip. An unusual complication of total knee arthroplasty. Clin Orthop Relat Res. 1992; (281):140–14.

31. Mikhail WE, Wretenberg PF, Weidenhielm LR, et al. Complex cemented revision using polished stem and morselized allograft. Minimum 5-years' follow-up. Arch Orthop Trauma Surg. 1999;119 (5–6):288–291.

32. Robinson DE, Lee MB, Smith EJ, et al. Femoral impaction grafting in revision hip arthroplasty with irradiated bone. J.Arthroplasty. 2002;17(7):834–840

33. Zalzal P, Gandhi R, Petruccelli D, et al. Fractures at the tip of long-stem prostheses used for revision hip arthroplasty. J. Arthroplasty. 2003;18(6):741–745.

34. Löwenhielm G, Hansson LI, Kärrholm J. Fracture of the lower extremity after total hip replacement. Arch Orthop Trauma Surg. 1989; 108(3):141– 143.

35. Peterson CA, Lewallen DG. Periprosthetic fracture of the acetabulum after total hip arthroplasty. J Bone Joint Surg Am. 199.

36. Abendschein W (2003) Periprosthetic femur fractures—a growing epidemic. Am J Orthop 32(9):34–36.

37. Brady OH, Garbuz DS, Masri BA, Duncan CP (1999) the treatment of periprosthetic fractures of the femur using cortical onlay allograft struts. Orthop Clin North Am 30(2):249–257.

PATIENT CONSENT FORM

Study detail:

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF PATIENTS WHO UNDERWENT TREATMENT FOR PERIPROSTHETIC FRACTURE FOLLOWING PRIMARY HIP ARTHROPLASTY

Study centre : GOVT. KILPAUK MEDICAL COLLEGE, CHENNAI

Patients Name :

Patients Age :

Identification Number :

Patient may check ( ) these boxes

I confirm that I have understood the purpose of procedure for the above study. I had the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected.

I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study.

I hereby make known that I have fully understood the use of above procedure, the possible complications arising out of its use and the same was clearly explained to me.

I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well-being or any unexpected or unusual symptoms.

I hereby consent to participate in this study.

I hereby give permission to undergo complete clinical examination and diagnostic tests including hematological, biochemical, radiological tests.

Signature/thumb impression:

Patients Name and Address: place date

Signature of investigator :

Study investigator's Name : place date

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF PATIENTS WHO UNDERWENT TREATMENT FOR PERIPROSTHETIC FRACTURE FOLLOWING PRIMARY HIP ARTHROPLASTY.

PROFORMA

BASIC DATA:

Study number:

Name: Age: Sex:

Hospital number:

Address: Contact number:

Occupation:

Date of admission:

Date of discharge:

Documented side: Right Left

Primary diagnosis:

Primary surgery:

Date of surgery:

Secondary diagnosis:

Secondary surgery:

Date of surgery:

Clinical history:

Presenting symptoms:

1. Pain: yes/ no if yes: duration:

Nature of pain:

2. Concomitant medical problems:yes/ no if yes:
Diabetes mellitus / obesity/ respiratory system/cardiovascular/ urologicalnervous system

3. Personal habits: h/o smoking / h/o alcohol

CLINICAL EVALUATION:

Inspection:

Measurements:

	Right	Left
Limb length:		

Investigations

Hb:

TC:

DC:

ESR:

Blood grouping typing:

Urine routine:

Renal function test:

Urea: Creatinine:

Serum electrolytes:

Na: k:

Coagulation profile:

LFT:

Others:

CRP: ECG: ECHO: PFT:

X-ray:

Operative notes:

Date of surgery:

Type of anaesthesia:

Spinal :

Epidural:

General anaesthesia:

Antibiotic prophylaxis:

Approach:

Type of fixation:

Revision with long stem:

Cerclage wire:

ORIF:

Intra operative transfusion:

Immediate post operative evaluation:

Pain:

Fever:

Neurovascular deficit:

Deep vein thrombosis:

Range of movements:

Radiological:

Evaluation at the time of discharge:

Pain:

Wound:

Range of movements:

Gait:

Walking with/ without support:

Follow up period:

6 weeks/ 3 months/ 6 months/ 1 year:

Pain:

Range of motion:

Deformities:

Function: based on walking/ climbing up stairs/ down stairs

Use of support/ without support:

Gait:

Radiological evaluation:

MASTER CHART

Name	Age	Sex	Primary diagnosis	Primary surgery	Secondary diagnosis	Secondary surgery	Time of fracture	Refracture	Limb shortening	Hardware failure	Infection	HHS	Result
Mr.A	52	Male	b/l AVN	b/l THR	C fracture	Revision with long stem	Intra operative	No	No	No	No	90	Excellent
Mr.B	81	Male	NOF fracture	Bipolar	B3 fracture	ORIF	Post operative	No	No	No	No	72	Fair
Mr.C	28	Male	Arthiritis	THR	C fracture	ORIF	Post operative	Yes	0.5cm	No	No	48	Poor
Mr.D	44	Male	NOF fracture	Bipolar	B1 fracture	ORIF	Post operative	No	No	No	No	70	Fair
Mrs.E	63	Female	NOF fracture	Bipolar	B2 fracture	Revision with long stem	Post operative	No	No	No	No	81	Good
Mr.F	35	Male	NOF fracture	Unipolar	B2 fracture	Revision with long stem	Post operative	No	No	No	No	70	Fair
MrsG	56	Female	AVN	THR	C fracture	ORIF	Intra operative	No	No	No	No	74	Fair
Mr.H	52	Male	NOF fracture	THR	B1 fracture	ORIF	Post operative	No	1cm	Yes	No	25	Poor
Mr.I	48	Male	NOF fracture	Bipolar	B1 fracture	Revision with long stem	Intra operative	No	No	No	No	91	Excellent

Mr.J	52	Male	Arthiritis	THR	A fracture	SS wire	Intra operative	No	No	No	No	82	Good
Mr.K	18	Male	b/l AVN	b/l THR	B2 Fracture	Revision with long stem	Intra operative	No	No	No	No	70	Fair
Mr.L	40	Male	NOF fracture	CCS fixation,Non union	A fracture	SS wire	Intra operative	No	No	No	No	78	Fair
Mr.M	51	Male	NOF fracture	THR	B2 fracture	Revision with long stem	Post operative	No	1cm	No	Yes	45	Poor
Mrs :N	55	Female	NOF fracture	Bipolar	B2 Fracture	ORIF	Post operative	No	No	No	No	72	Fair
Mr.O	45	Male	AVN	THR	B1 fracture	ORIF	Post operative	No	No	No	No	81	Good